



National Weather Service
Gaylord Michigan

2006 Storm Spotter and Safety Course

Spotter Talk Agenda

- Why are spotters important?
- Thunderstorm Basics
- Science of tornadoes and downbursts
- Waterspouts
- Reporting criteria
- Viewing angles
- Safety and making a report
- Summary and conclusions

Why are SKYWARN (Severe) Weather Spotters so important?

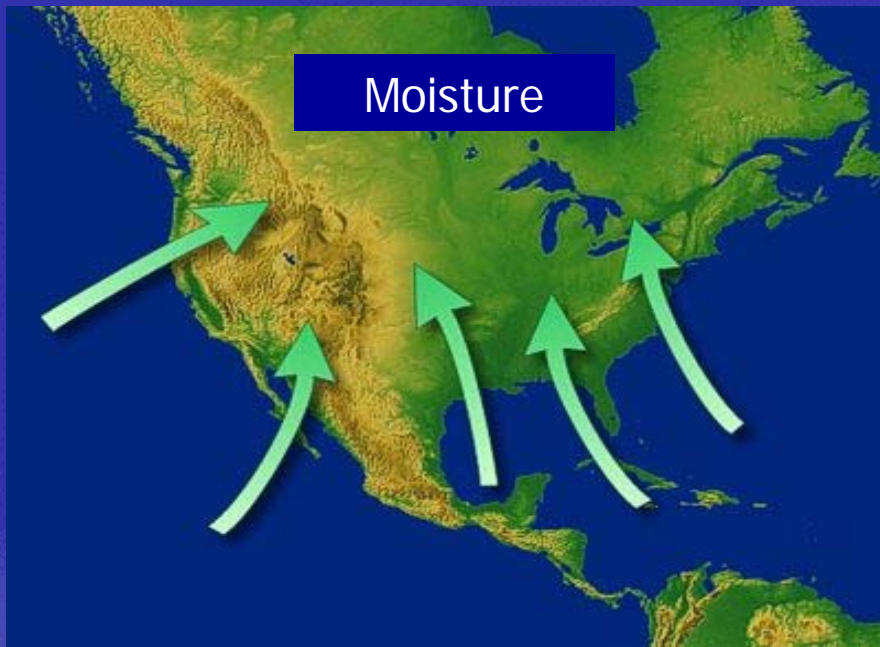
- Help overcome Doppler Radar limitations
- Provide ground truth which can be correlated with radar signatures *prior to, during, and after* severe weather
- Ground truth reports in warnings heighten public awareness and allow us to have confidence in our warning decisions

What 3 things do thunderstorms need in order to develop?



- Moisture
- Instability
- Lift

Moisture

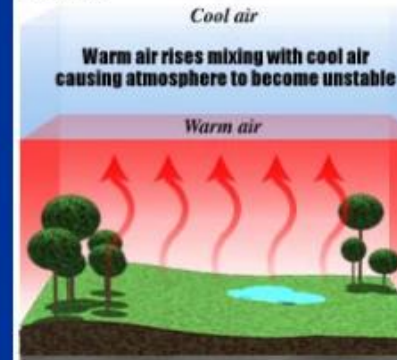


Instability

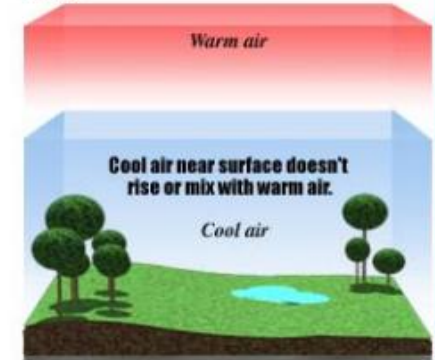


How atmosphere becomes stable or unstable

Unstable



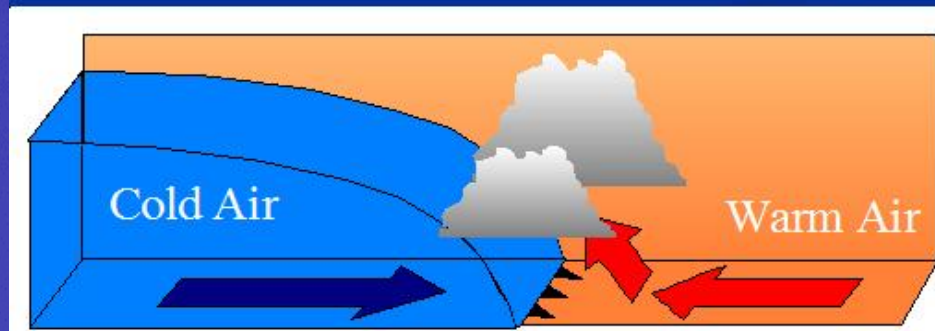
Stable



Lift associated with cold front



- Colder more dense air pushes underneath warmer moist air, creating condensation and cloud development.
- Air converges along a frontal boundary, forcing it to rise.



Thunderstorm Life Cycle

Developing Stage

Towering Cumulus (rising air)

Usually little if any rain

Lasts about 10 minutes

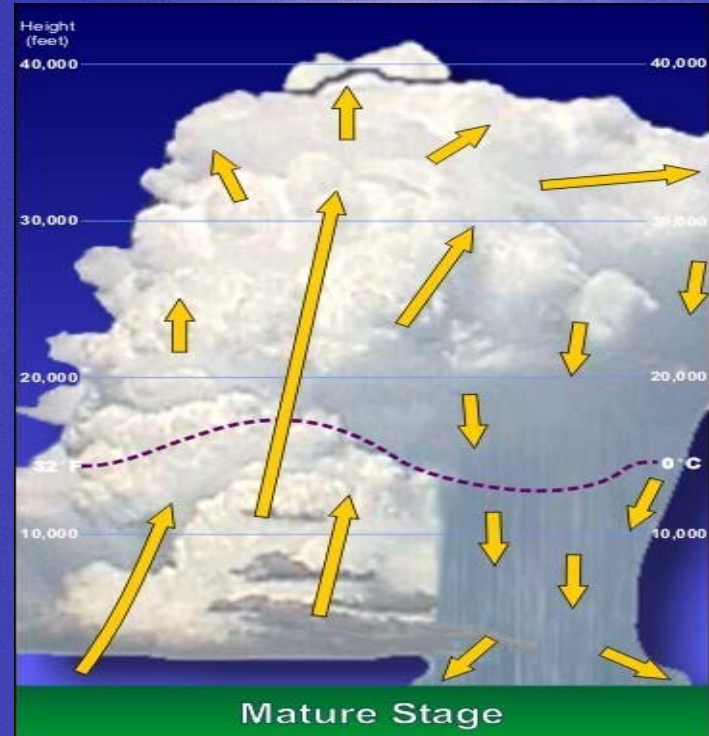
Occasional lightning

Mature Stage

Most likely time for hail
heavy rain, frequent
lightning, strong winds, and
tornadoes

Storm may have black or
dark green appearance

Lasts an average of 10 to 20
minutes, but may last much
longer



Dissipating Stage

Rainfall decreases in intensity

Can still produce a burst of strong winds

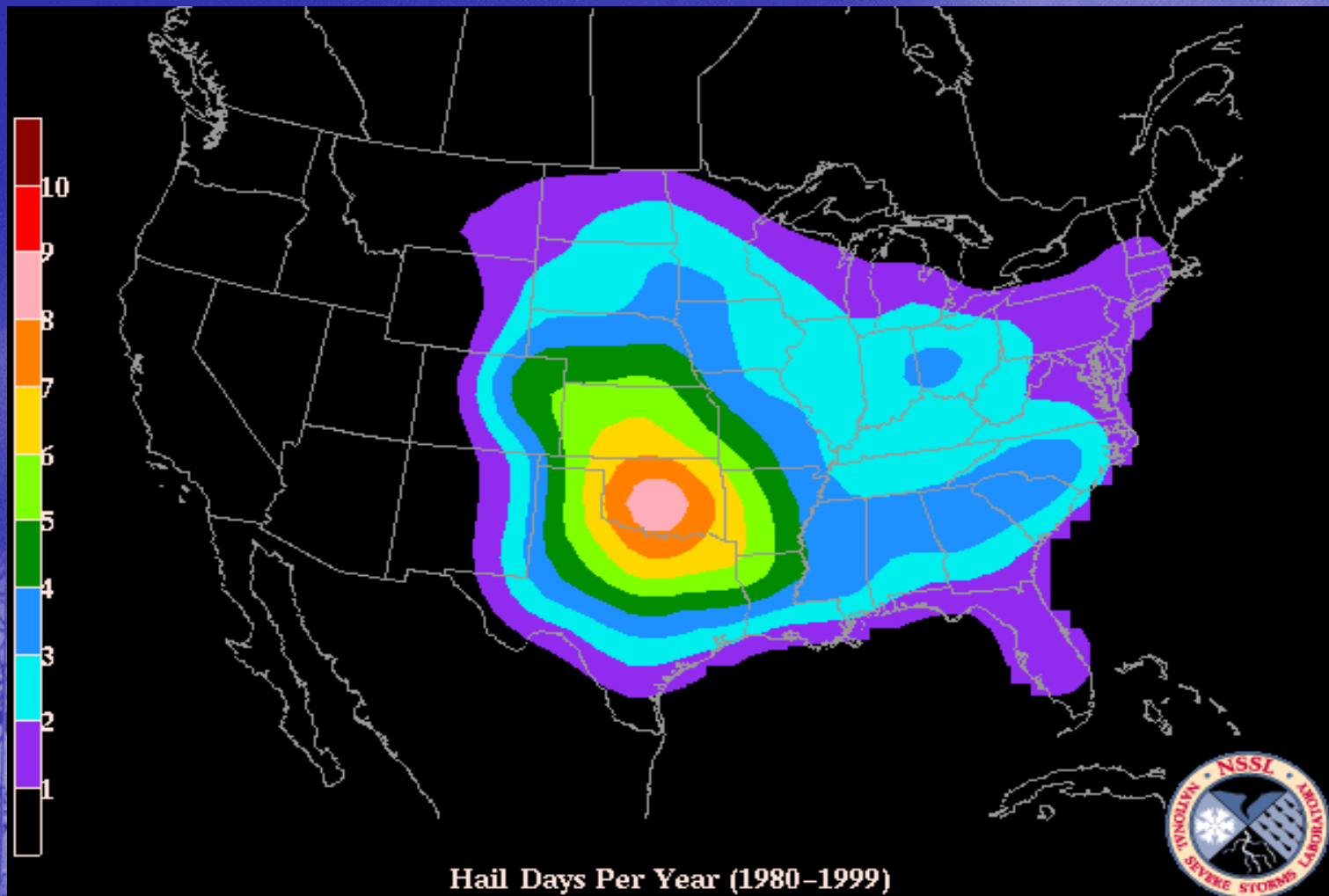
Lightning remains a danger

Let's look at a few thunderstorm hazards...

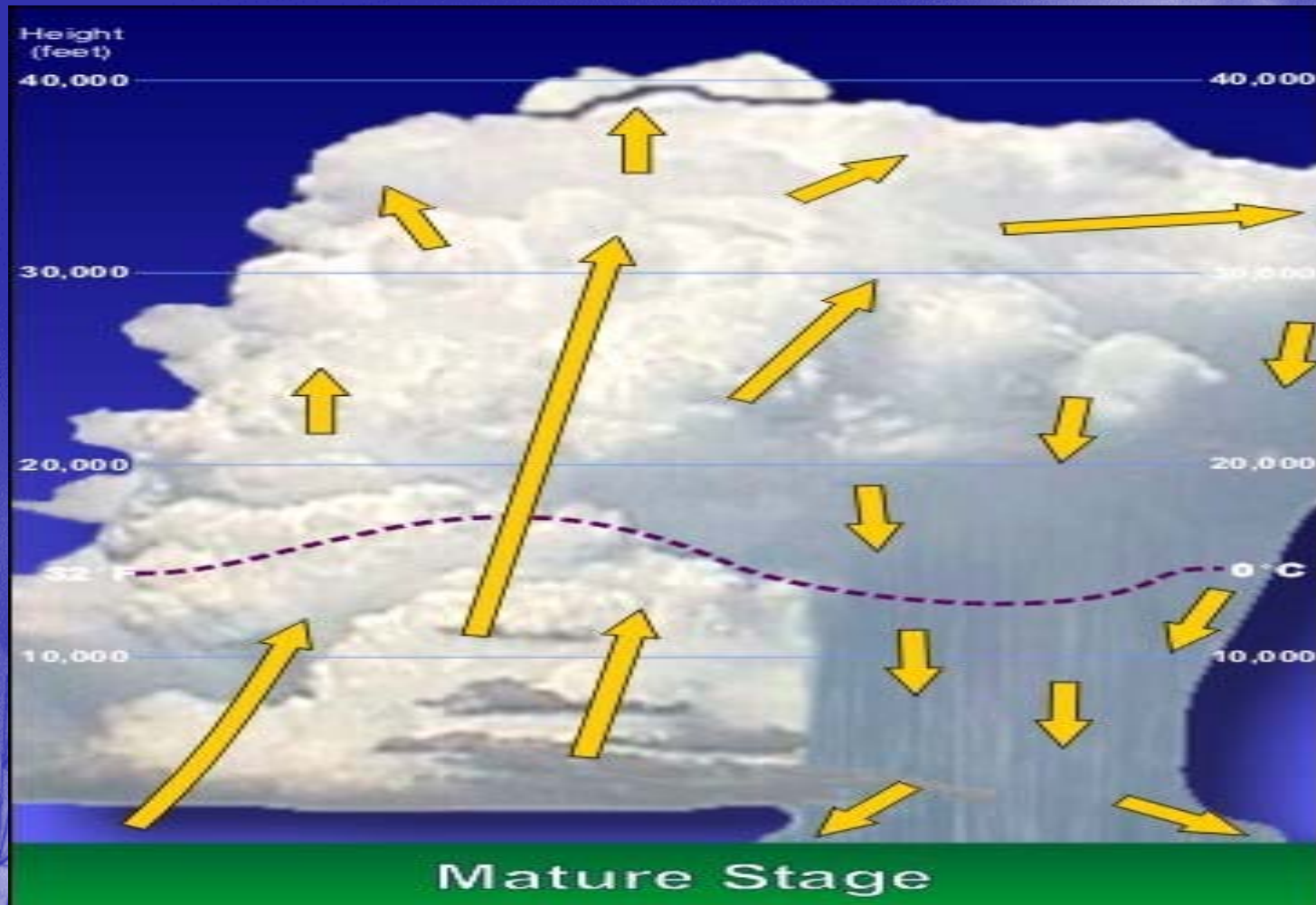


$\frac{3}{4}$ " Hail Days per year

1980-1999 (Graphics from NSSL)

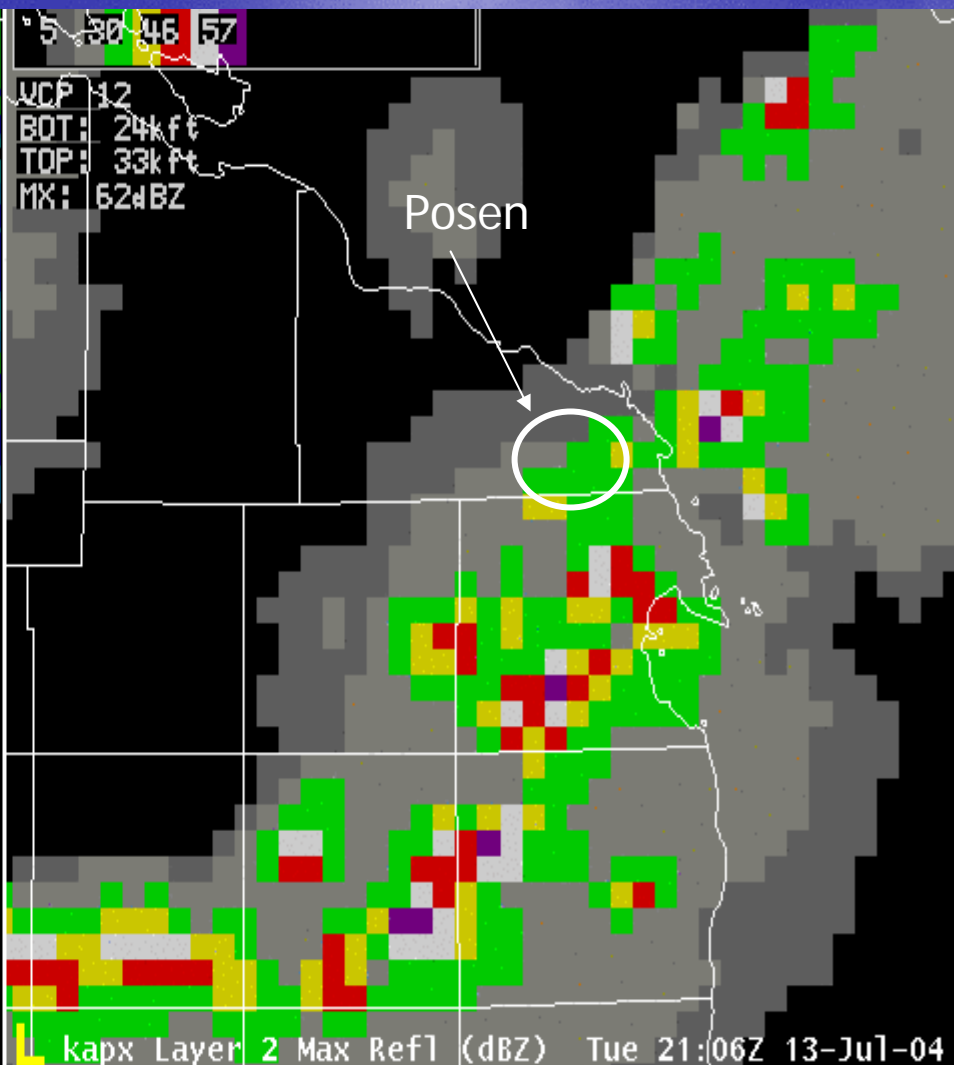
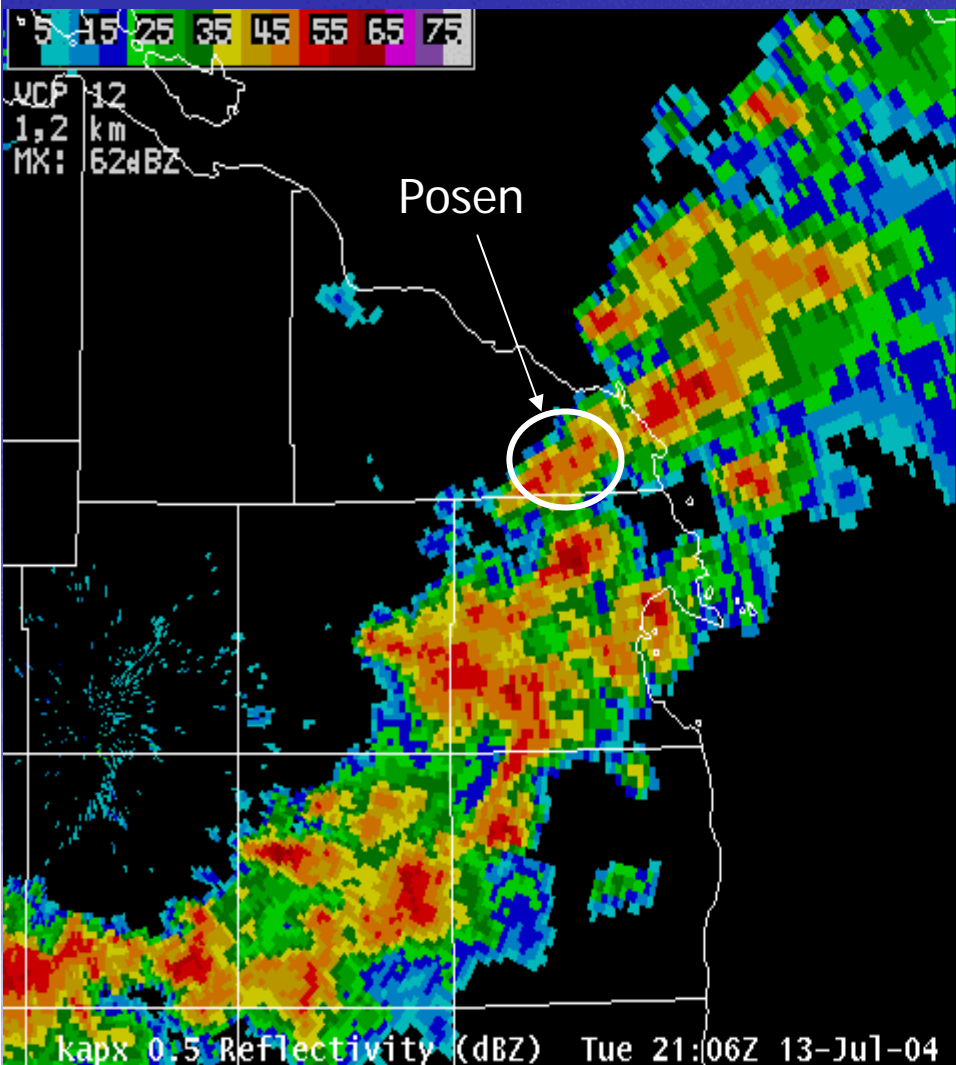


How does hail form?

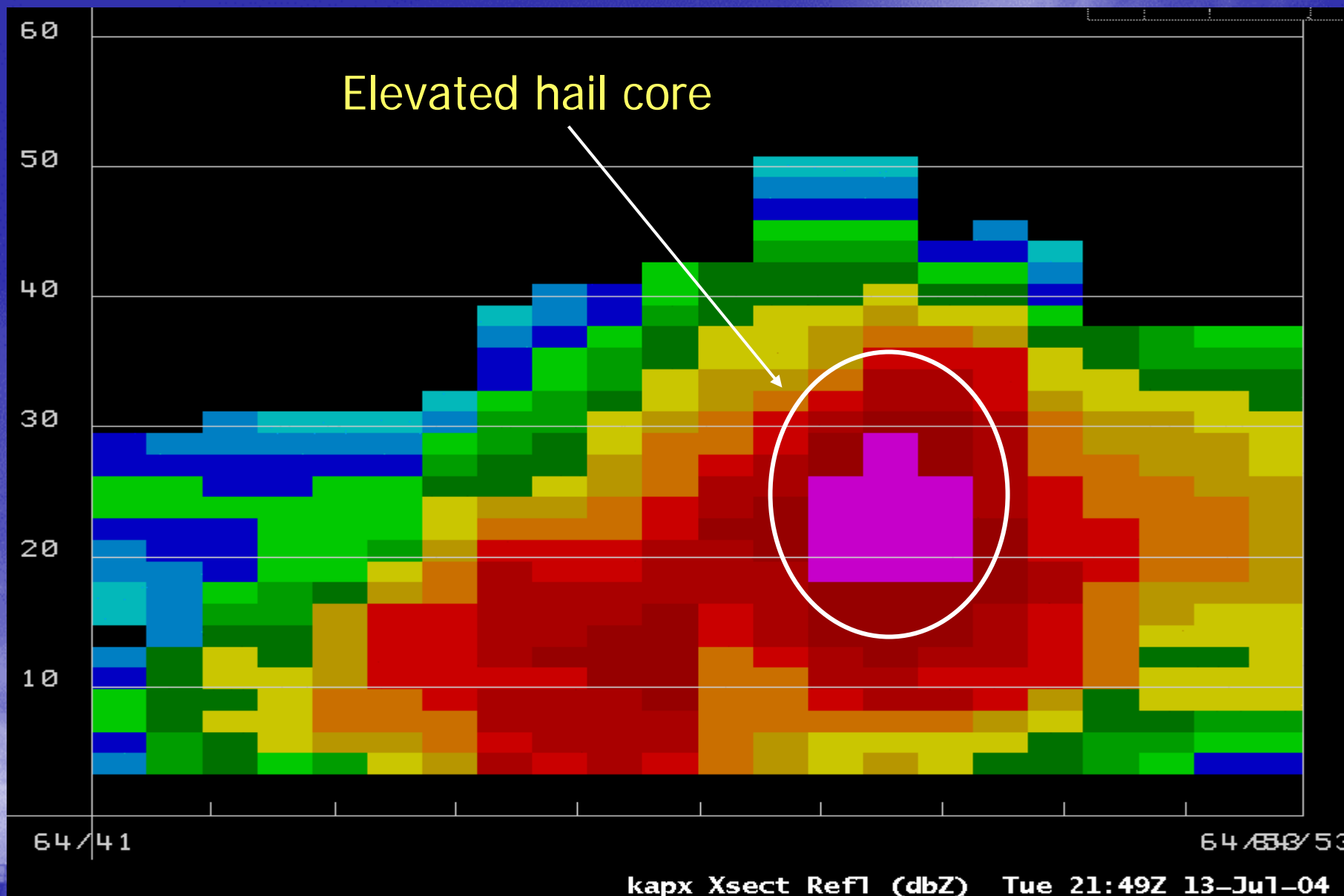


Where is it in the storm?

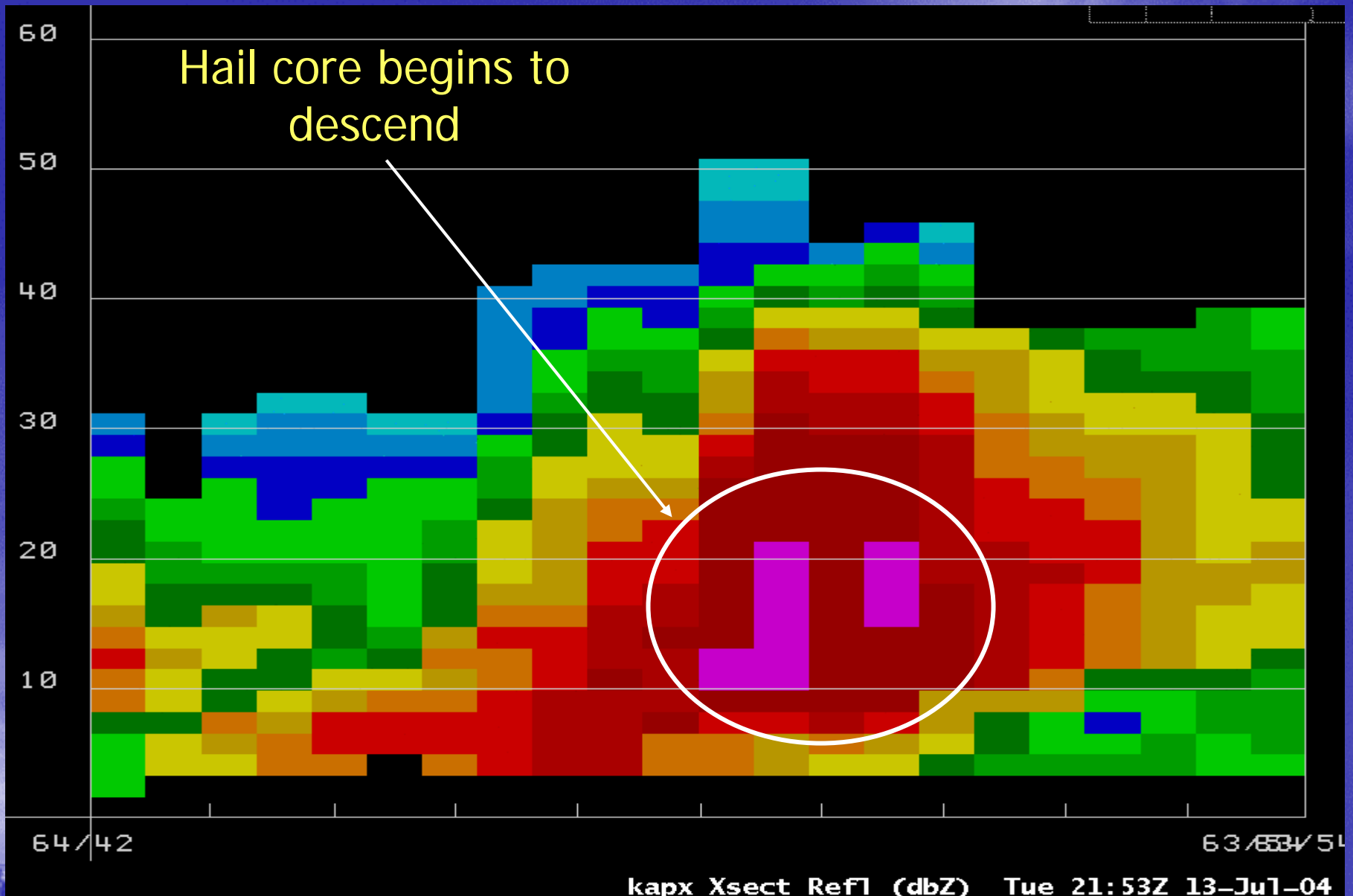
Posen Hail Storm July 13, 2004



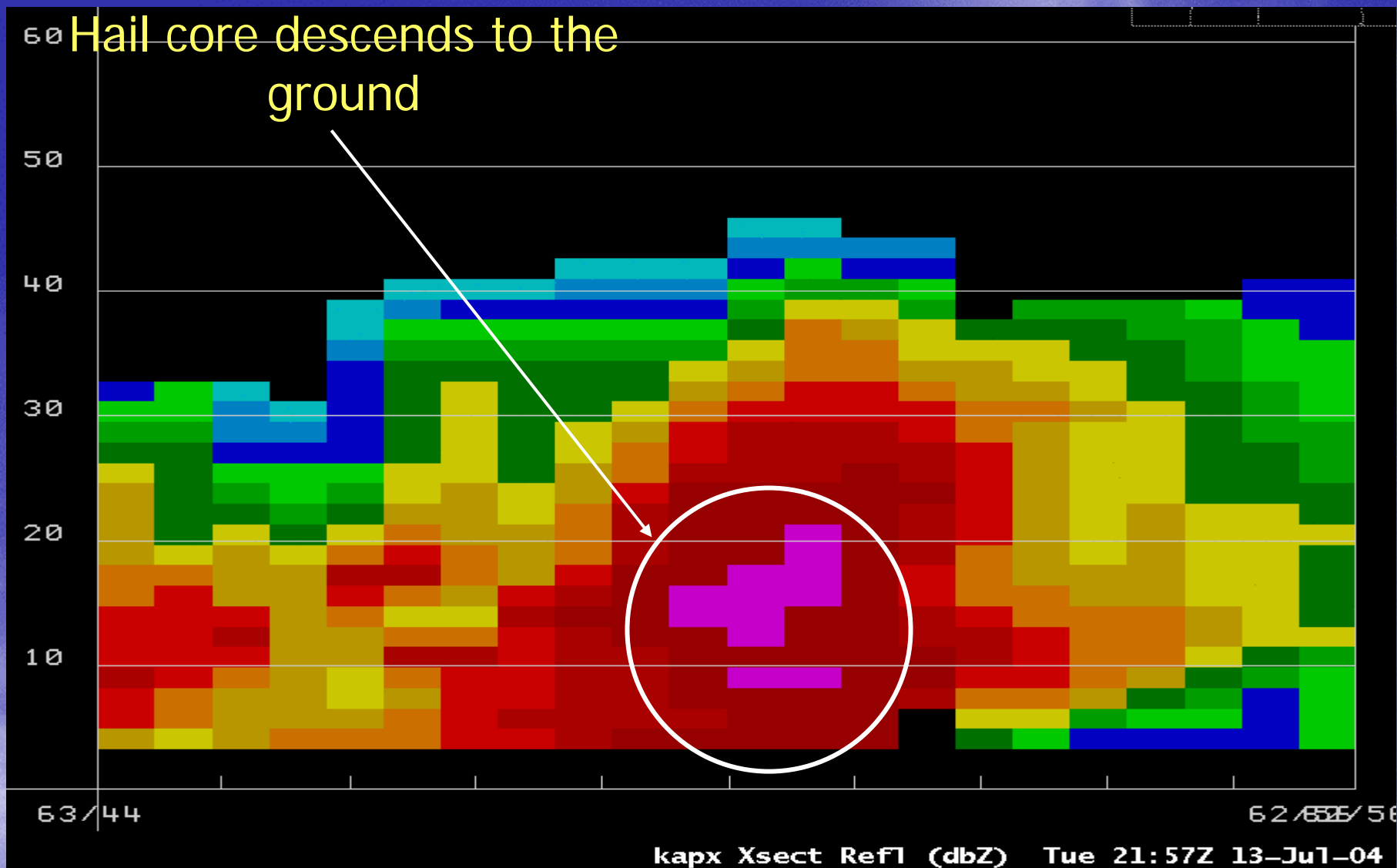
Cross Section of the Posen Hail Storm 549 PM



Cross Section of the Posen Hail Storm 553 pm



Cross Section of the Posen Hail Storm 557 pm



Cloud clues to identify hail producing thunderstorms

Overshooting Top



Anvil with overshooting top

Cloud clues to identify hail producing thunderstorms

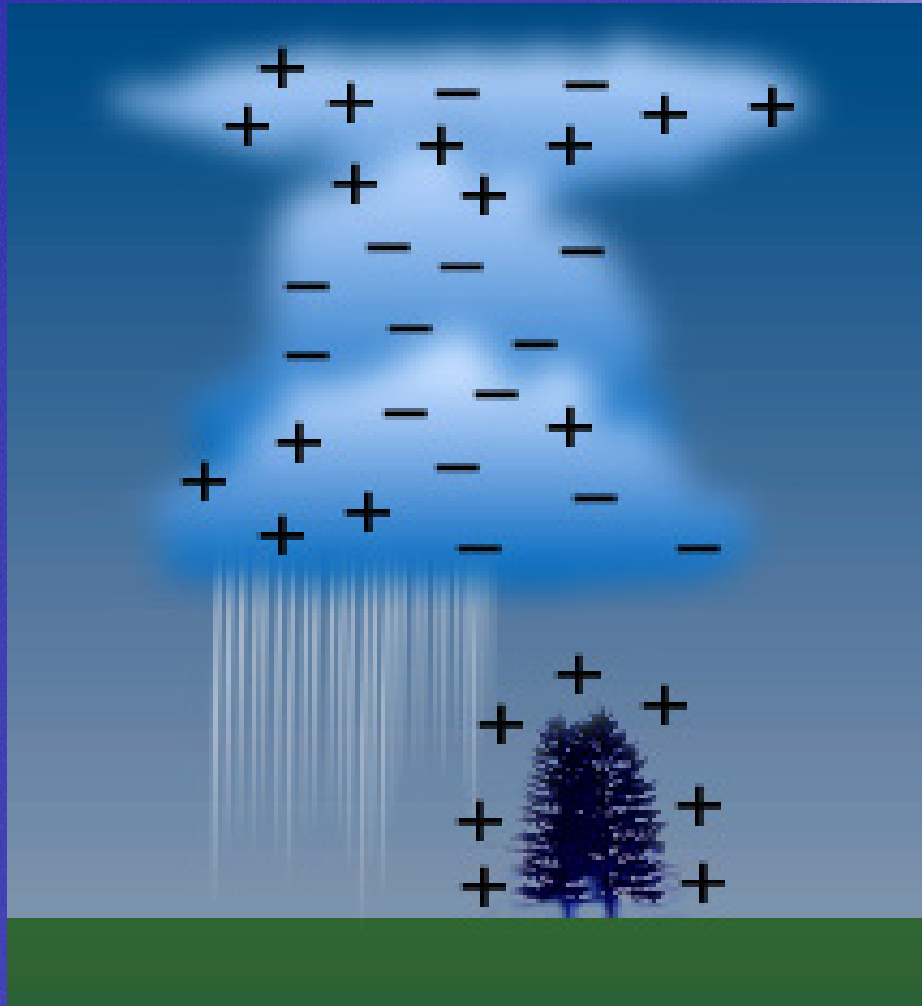


Bright white columns

Lightning



How does lightning form?



Lightning Matching Game

1959-1994 Source: NOAA

Match the percentage with the activity where people were struck by lightning (either injured or killed)

40%

27%

19%

8%

3%

2%

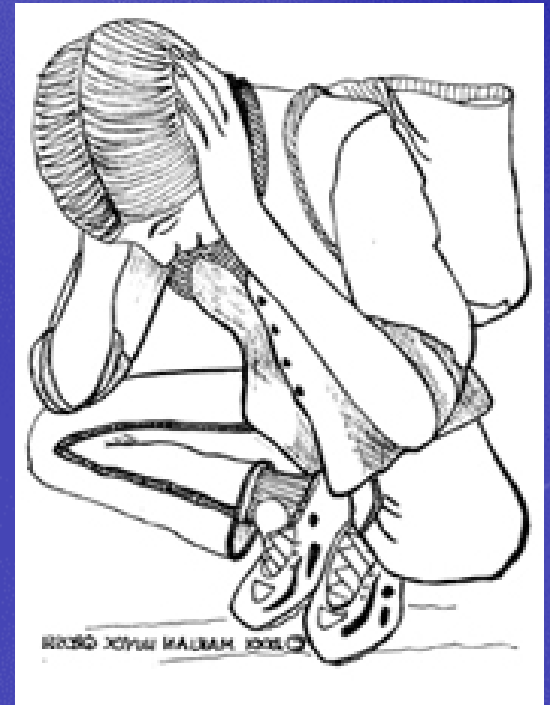
1%

1. Golf and/or standing under trees
2. Water Related
3. Telephone
4. Open fields and recreation areas (not golf)
5. Heavy equipment related
6. Unreported
7. Radio and/or antenna related

Lightning Safety

Remember, if you can hear thunder, you are close enough to be struck by lightning!

- If lightning is occurring move to a sturdy building or car
- Stay away from tall objects
- Avoid using phones or electrical appliances
- If caught outdoors, find a low spot away from tall objects
- If you feel your skin tingle or hair stand up, squat low to the ground on the balls of your feet



Flooding – The #1 weather killer



Miami County Indiana - July 15, 2003

Yes, it does flood in Northern
Michigan...



Flooding in Arenac County, 2004



Flood safety tips

- Never drive across areas where water covers the road
- Each foot of water displaces about 1500 pounds of vehicle
- Be especially cautious at night, when flash flooding is harder to recognize



Final flooding thought: When in doubt, stay out!



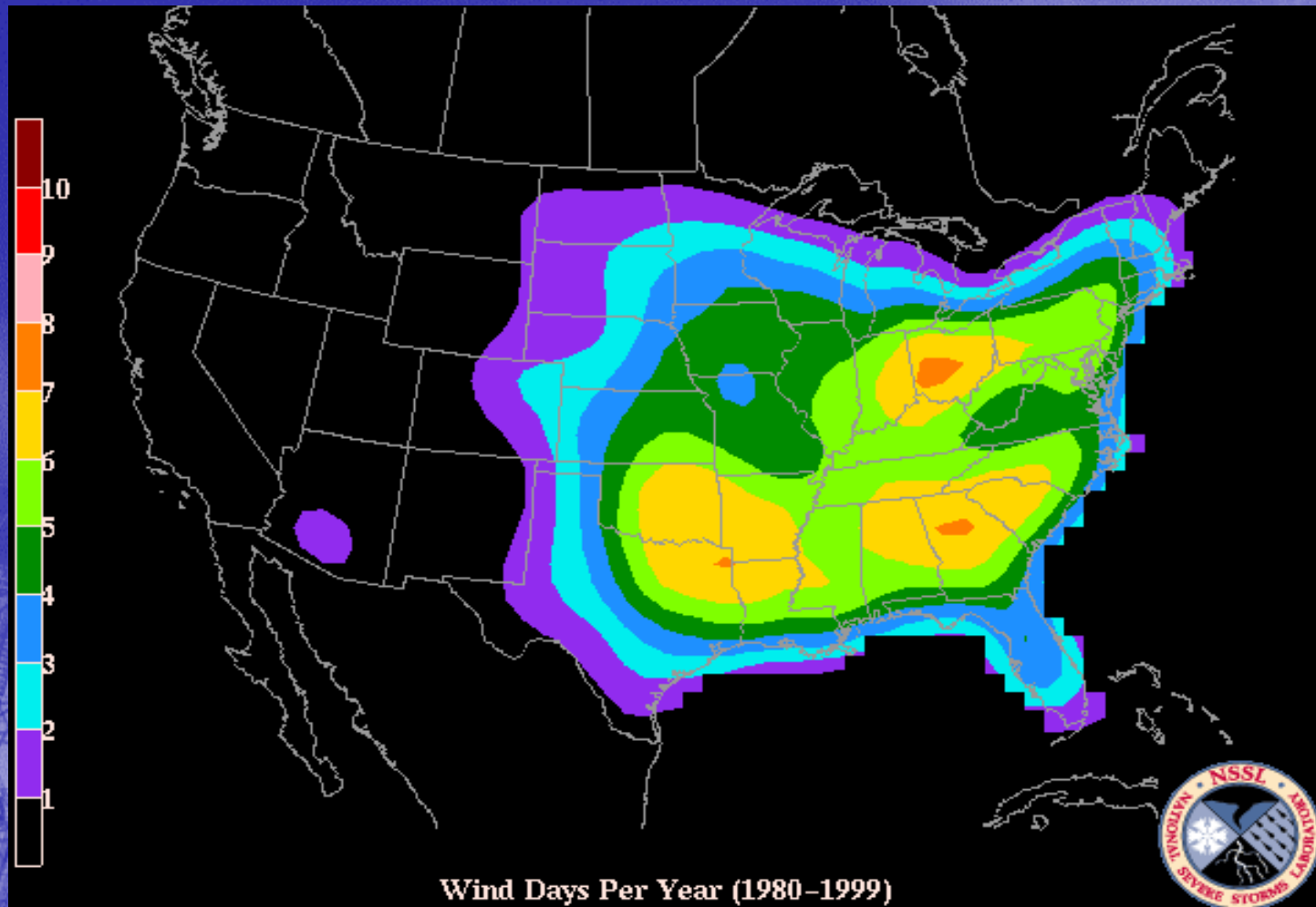
Non-tornadic thunderstorm winds

- Most of the wind damage in northern Michigan is in the form of straight line winds
 - Downburst
 - Squall line (bow echo)



58+ mph Wind Days Per Year

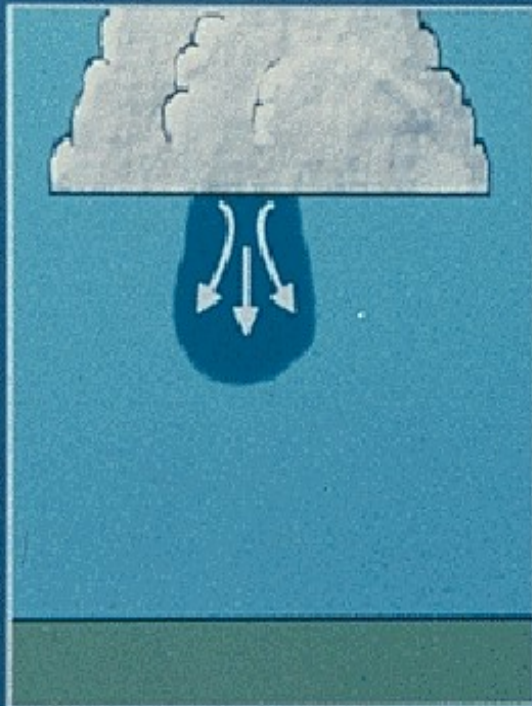
1980-1999 (Graphic from NSSL)



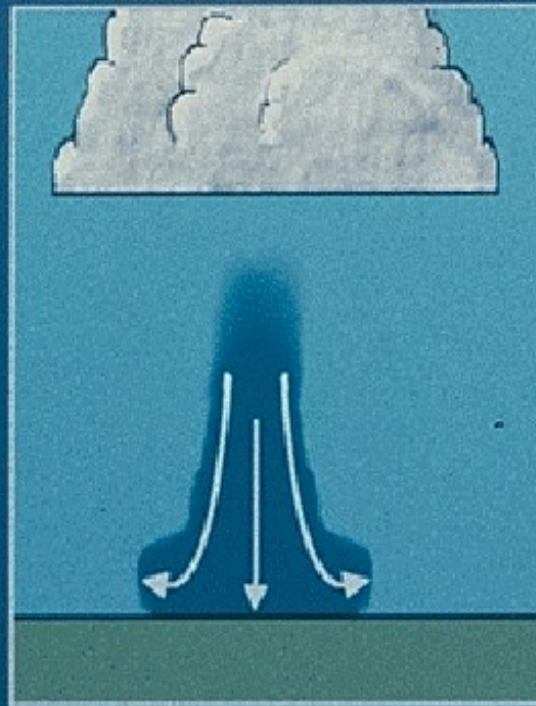
Downbursts



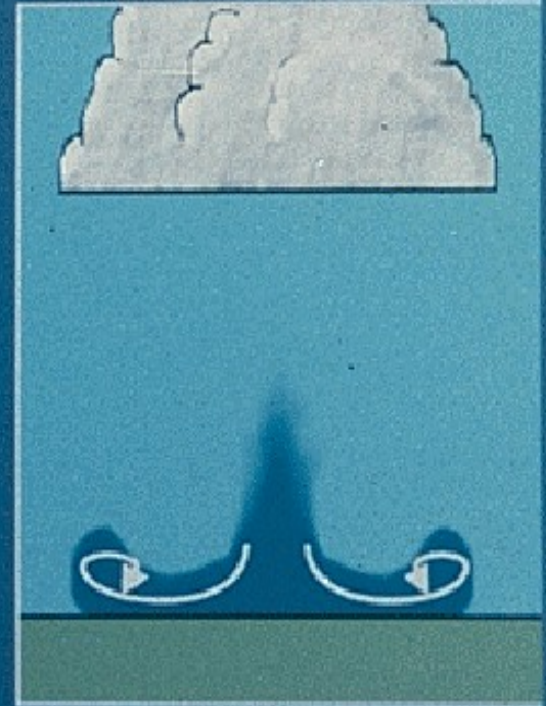
Downburst Life Cycle



FORMATION -
Evaporation and
precip. drag
forms downdraft



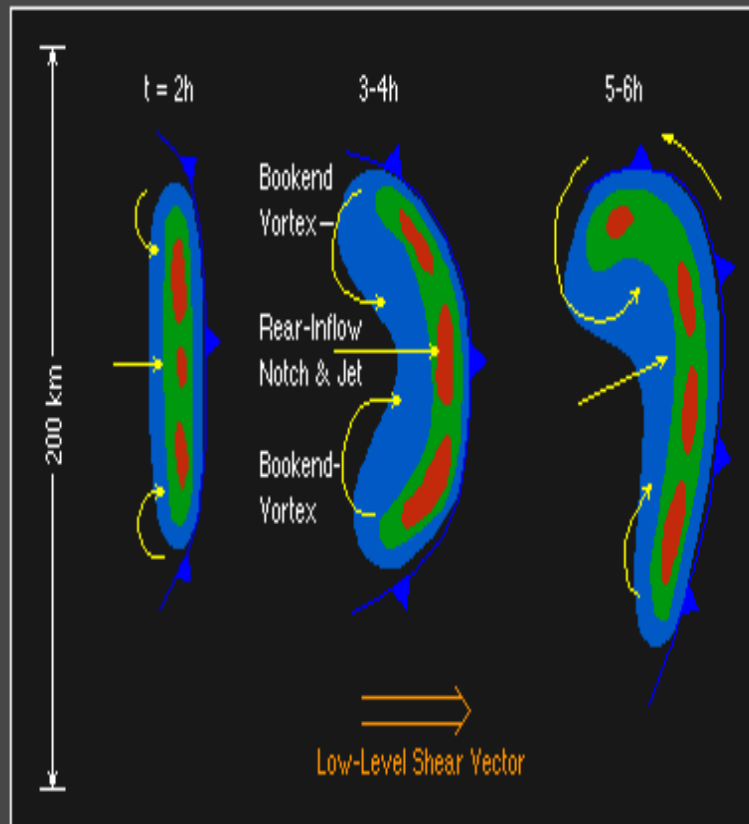
IMPACT -
Downdraft quickly
accelerates and
strikes ground



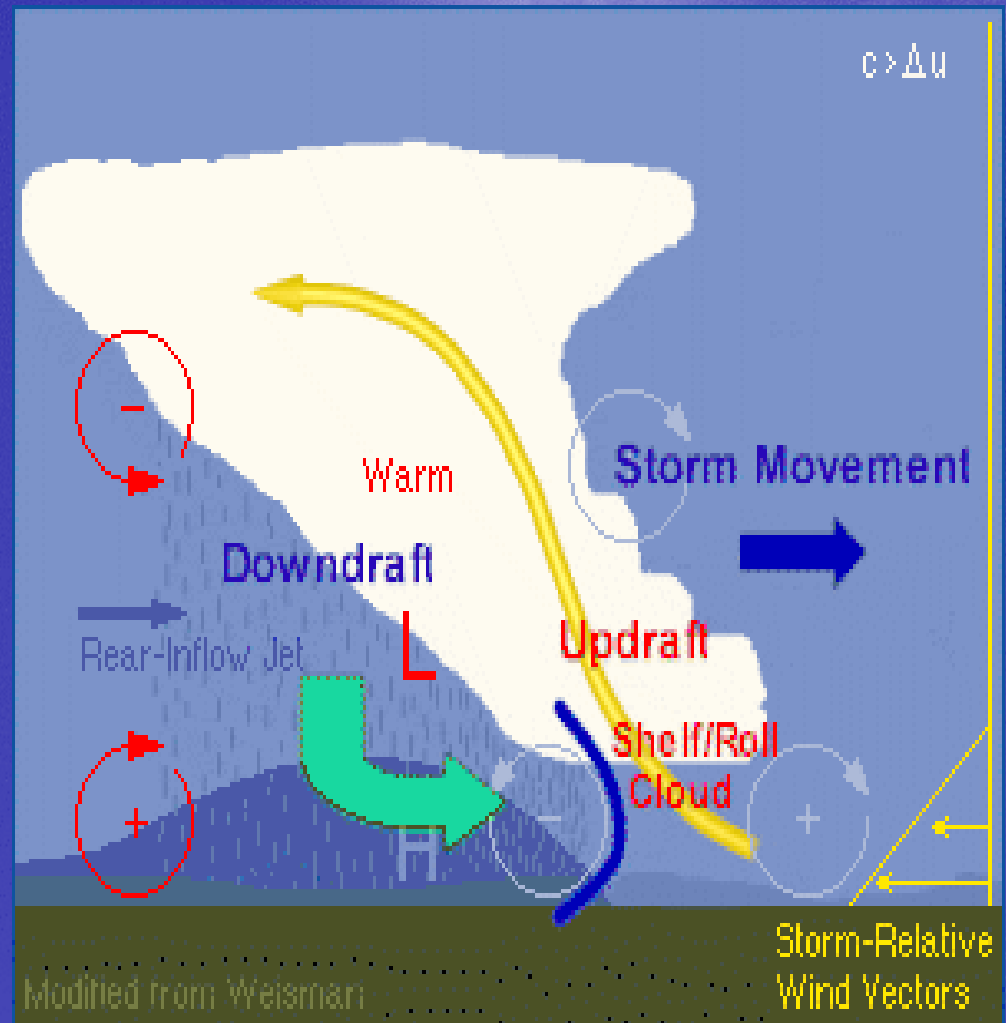
DISSIPATION -
Downburst moves
away from point
of impact

The Squall Line

Moderate-Strong Shear Bow Echo Evolution with Mid-Level Storm-Relative Flow



The COMET Program



Common cloud seen with squall lines - Shelf cloud

Outflow feature



Safety from Thunderstorm Winds

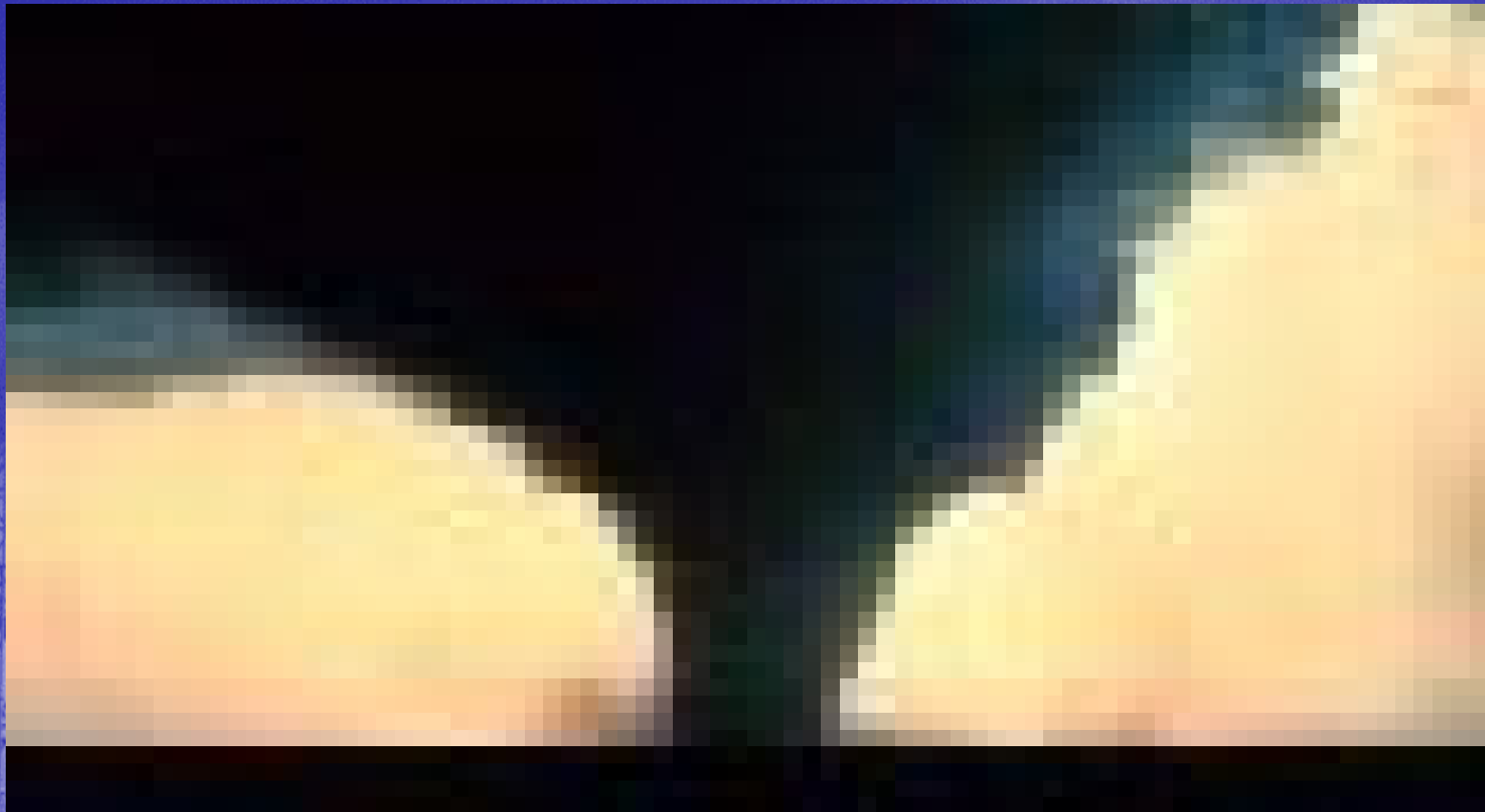
Winds can be as strong or stronger than many tornadoes. Flying debris causes the majority of injuries, so stay away from windows!

- If caught outdoors, move inside away from windows.
- If in your car, slow down and find a safe place to pull off (if possible, get out and go inside a building)

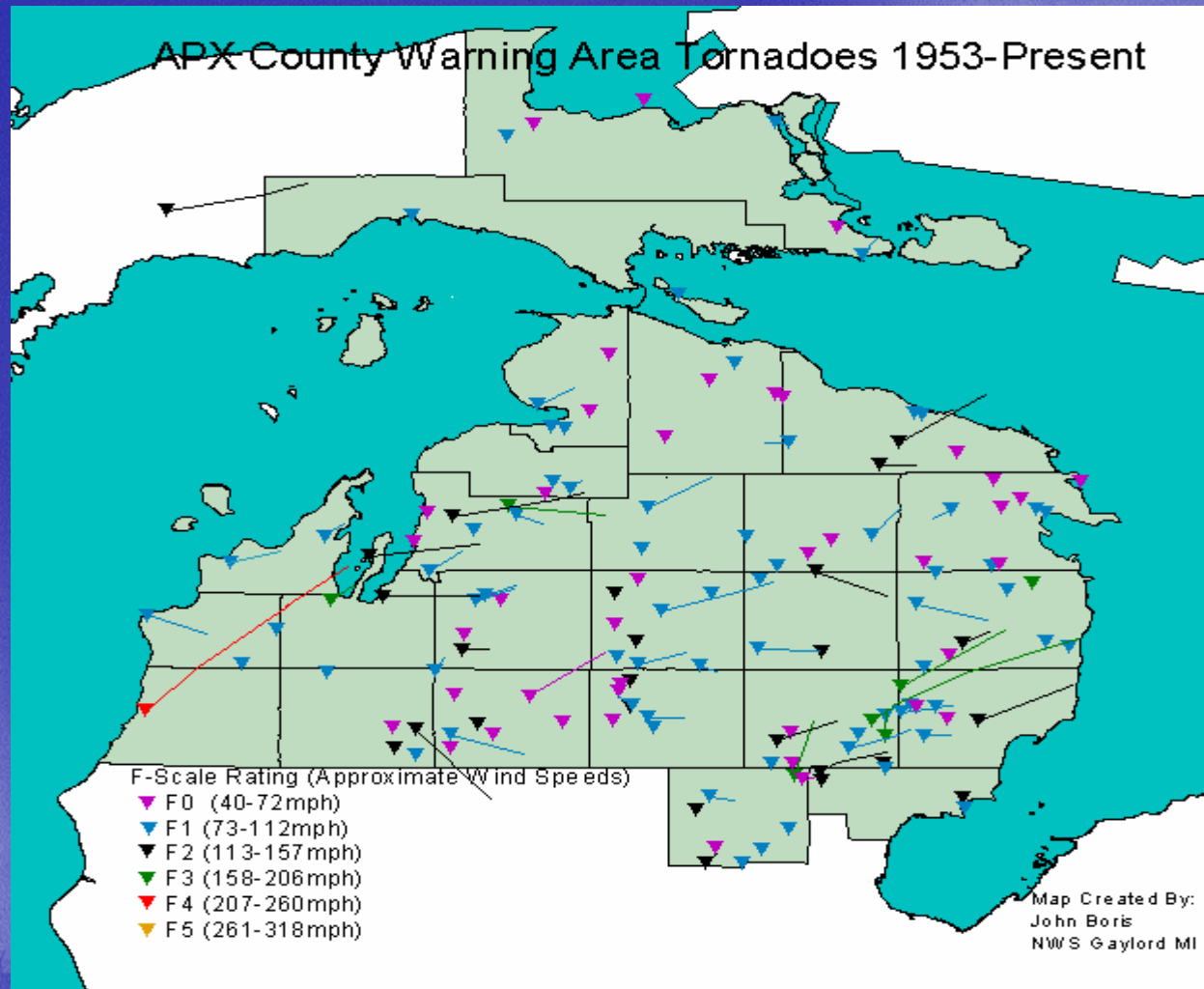


Tornadic Thunderstorms

Long lived thunderstorms with rotating updrafts (supercells)

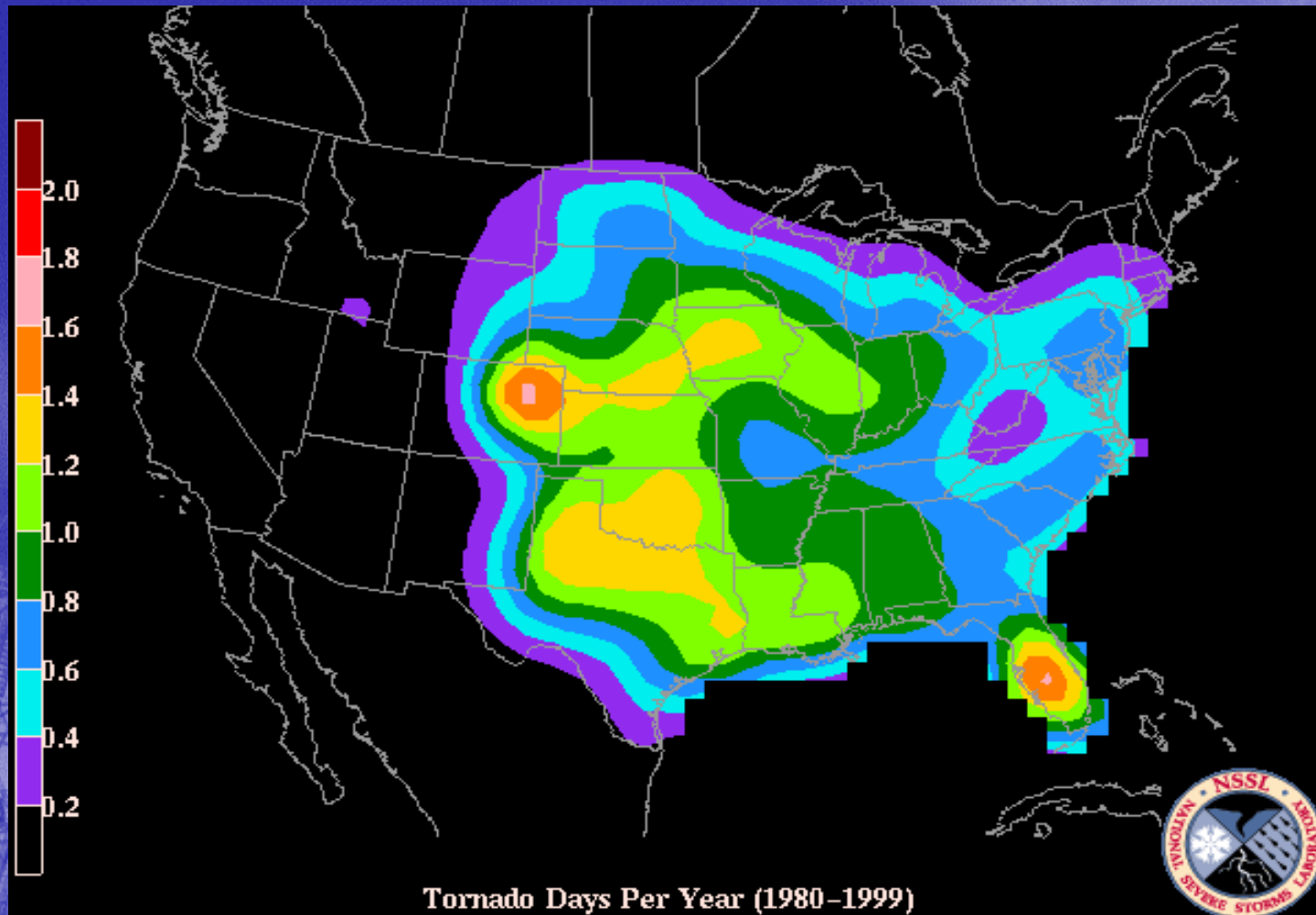


Tornadoes in Northern Michigan 1953 - Present

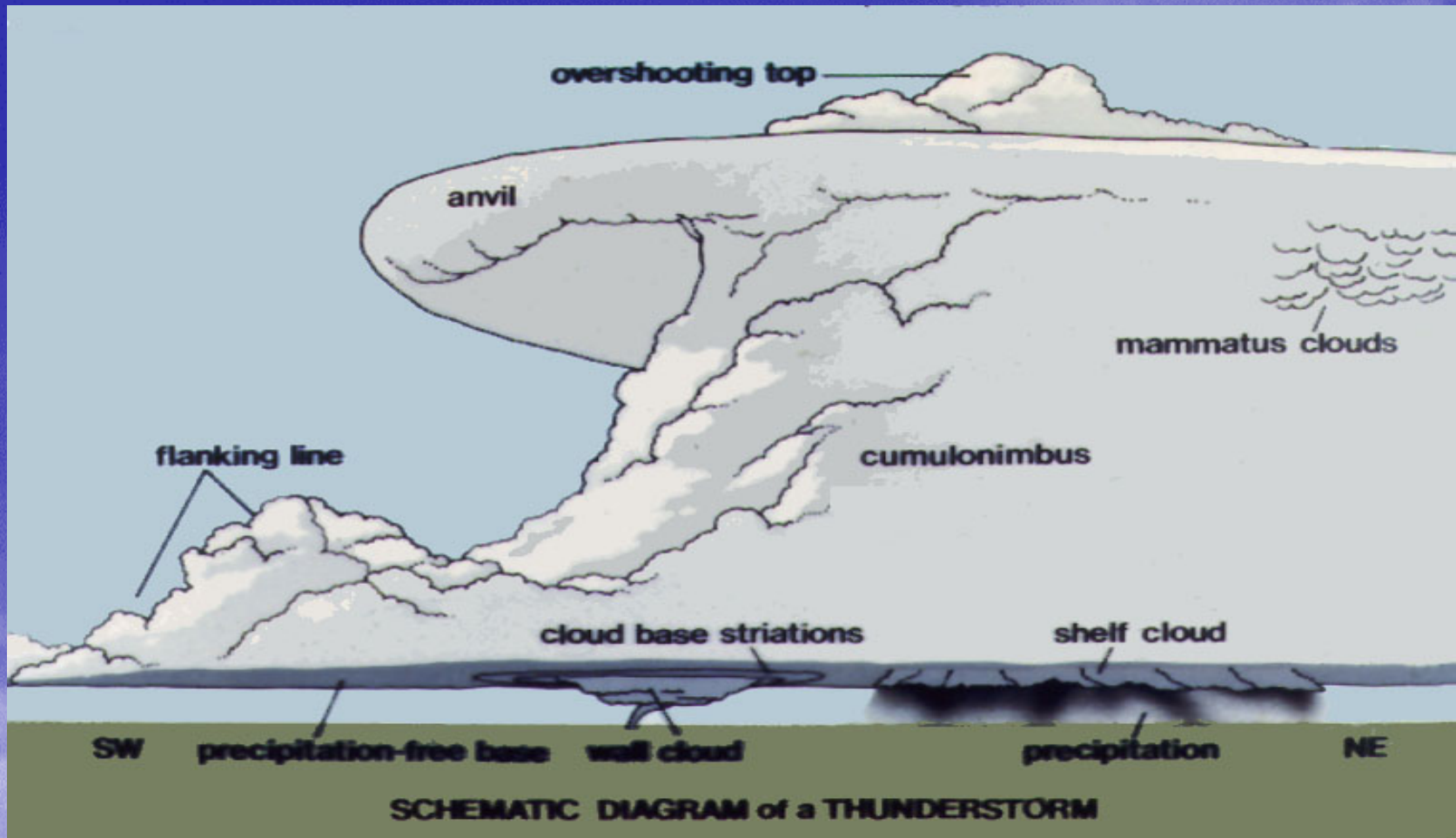


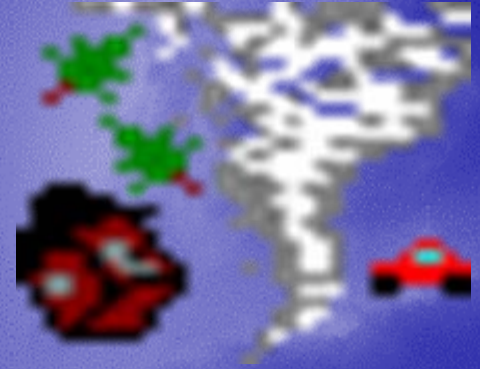
Tornado Days per year

1980-1999 (Graphics from NSSL)



Side View of Supercell



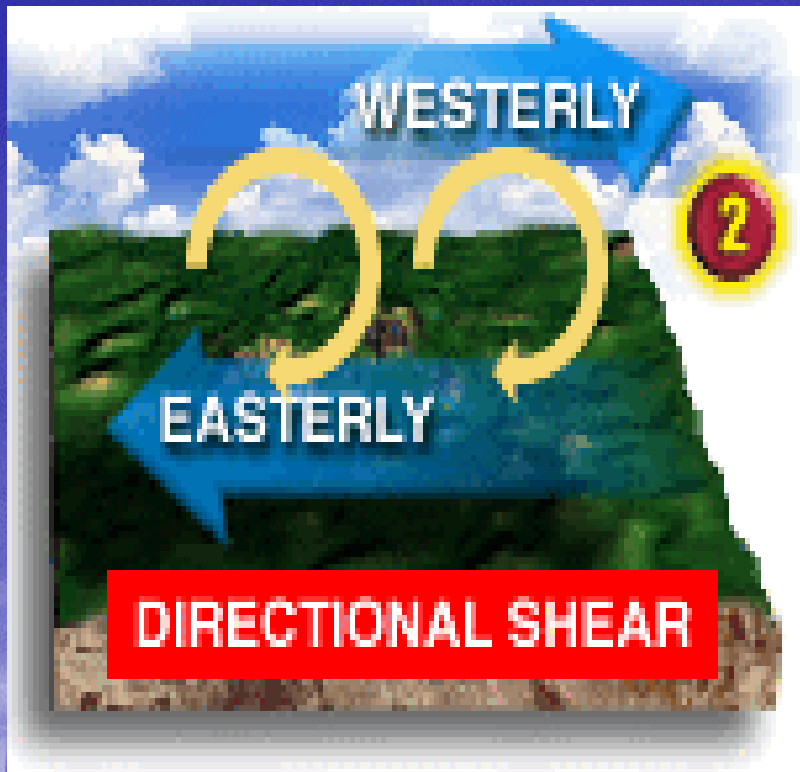


How do tornadoes form?

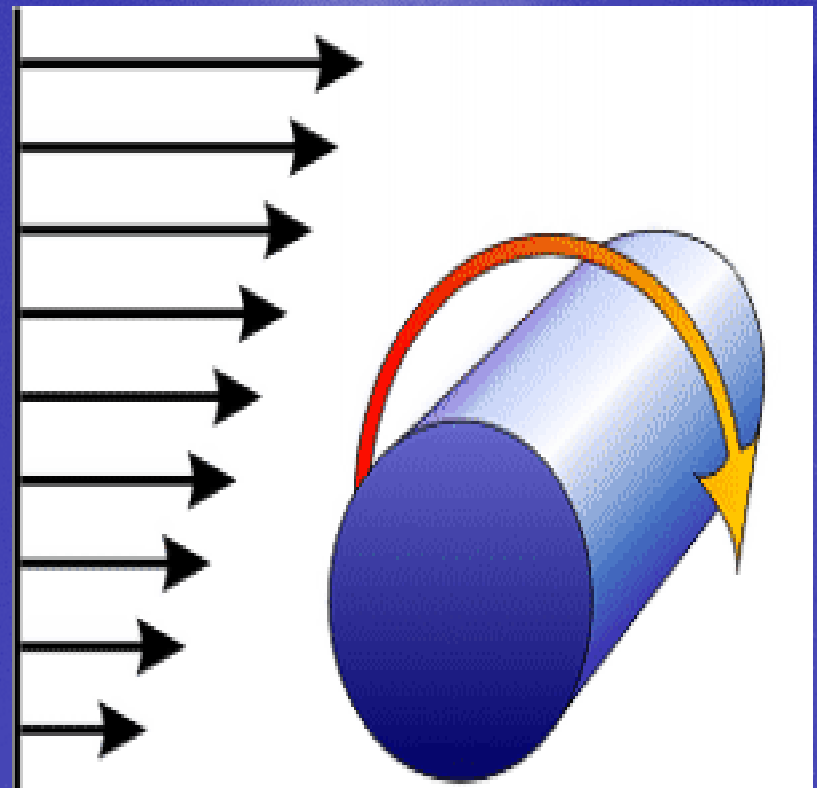


Wind shear

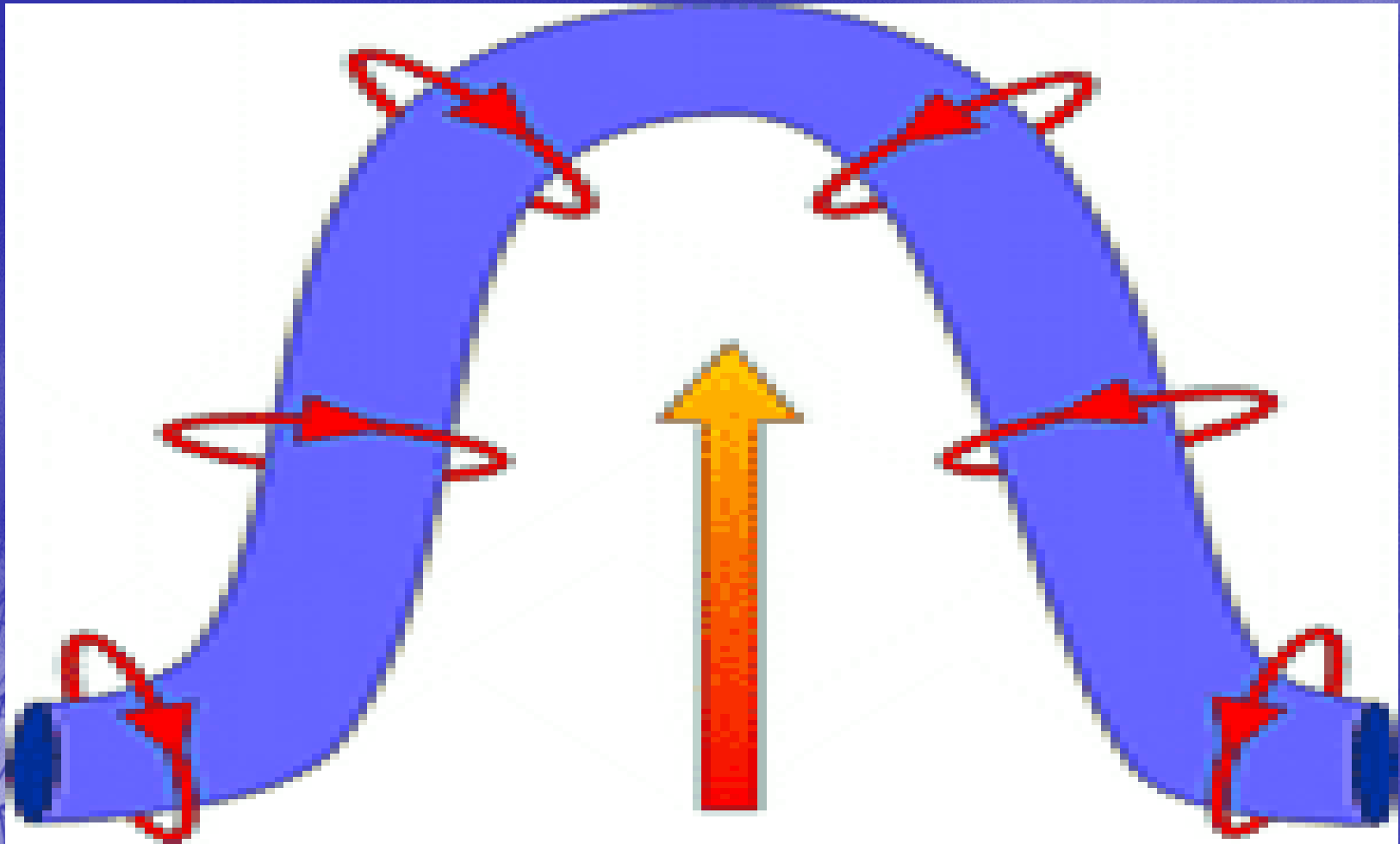
Directional wind shear



Speed wind shear



Rotation in the horizontal becoming
rotation in the vertical



Tornado safety

- Interior room on the lowest floor
- Cover yourself with blankets to protect yourself from flying debris/glass
- In cars and mobile homes, get out and find a more substantial shelter
 - Do not take cover beneath an overpass
- If you can't find a structure, lie flat on the ground in a low spot (i.e. ditch)

Waterspouts

2 types – tornadic and non-tornadic

- Tornadic - A tornado over water associated with a thunderstorm. If these make landfall, they continue on land as a tornado.
- Non-tornadic - Typically occur in the early fall as cold air moves over the relatively warm waters of the Great Lakes. They dissipate rapidly upon landfall. These are much more common in Michigan than tornadic waterspouts.

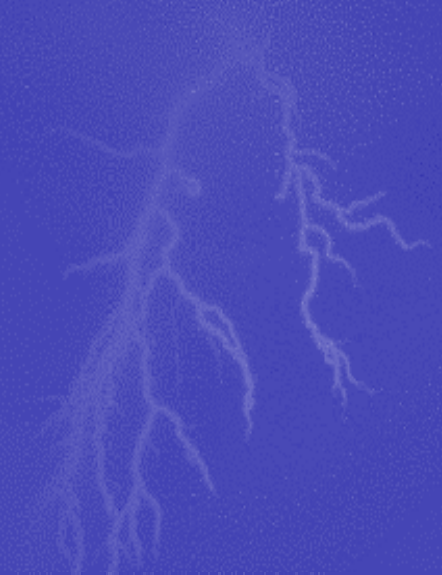
Waterspout on the Great Lakes

A boat?



Severe weather reporting

- National Weather Service criteria and definitions
- Hail
- Wind
- Don't be fooled



What Makes a Thunderstorm Severe?

- Tornado
- Winds at least 58 mph
- Hail at least $\frac{3}{4}$ inch in diameter

Aurora, NE
June 22, 2003



Arenac County,
June, 2005



NW Ticket Barn Wed Oct 24 16:14:38 2001



Watch versus warning

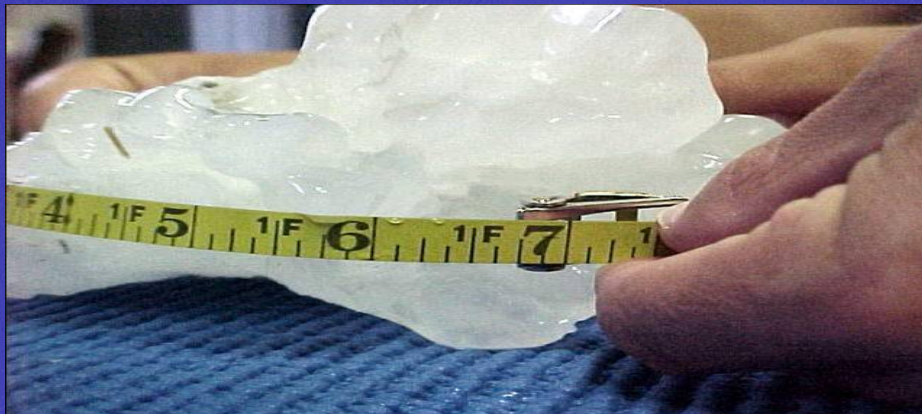
- **Warning** - Issued when a particular severe weather hazard is either imminent or is occurring. Take immediate action to protect life and property.
- **Watch** - Issued when conditions are favorable for a particular severe weather hazard to occur in the next several hours. Plan, prepare, and be aware.

Estimating Hail Sizes



Tips to making good hail estimates

- First and most important, be safe. DO NOT go outside to measure hail during the storm.
 - Stay away from windows
- Measure hail as soon as possible after the storm.
- There are several tools you can use to get a hail size
 - Hail estimation cards, rulers (calipers most accurate), hail boards



Do not give hail sizes with regard to marbles
















Marble size hail can mean many different things – avoid the confusion and use coins or inches.

Estimating and reporting wind speeds and damage



Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

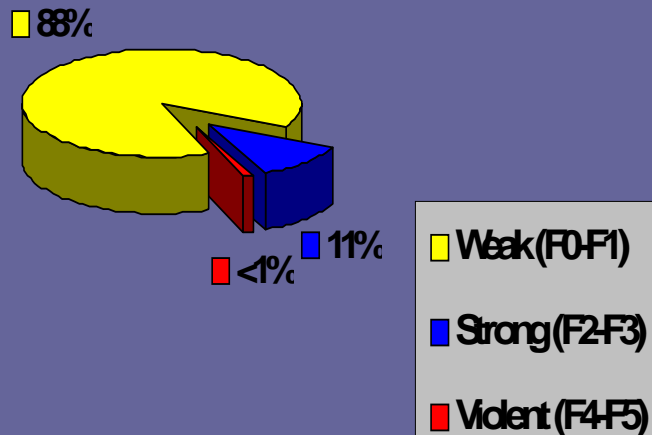
Fujita Scale

Weak - <110 mph winds

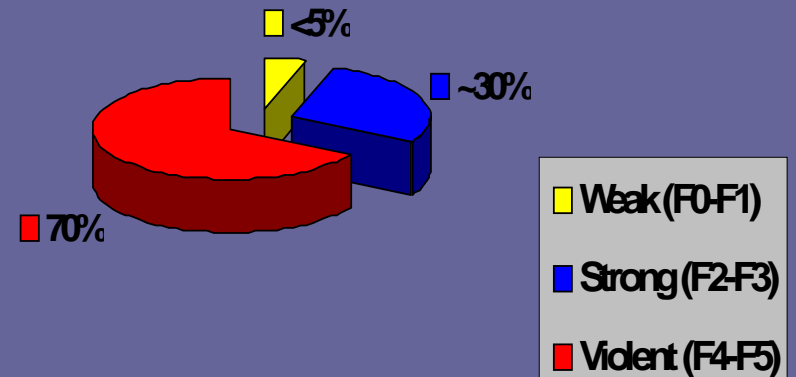
Strong - 110-205 mph winds

Violent - >205 mph winds

Percent of All Tornadoes by Fujita Scale Classification



Percent of Tornado Related Deaths by Fujita Scale Classification



So what should your wind report include?



Tree damage



Grayling, Michigan June 2005

Roof or shingle damage



Crawford County, Michigan July, 2005

Buildings damaged or blown down



Other damage

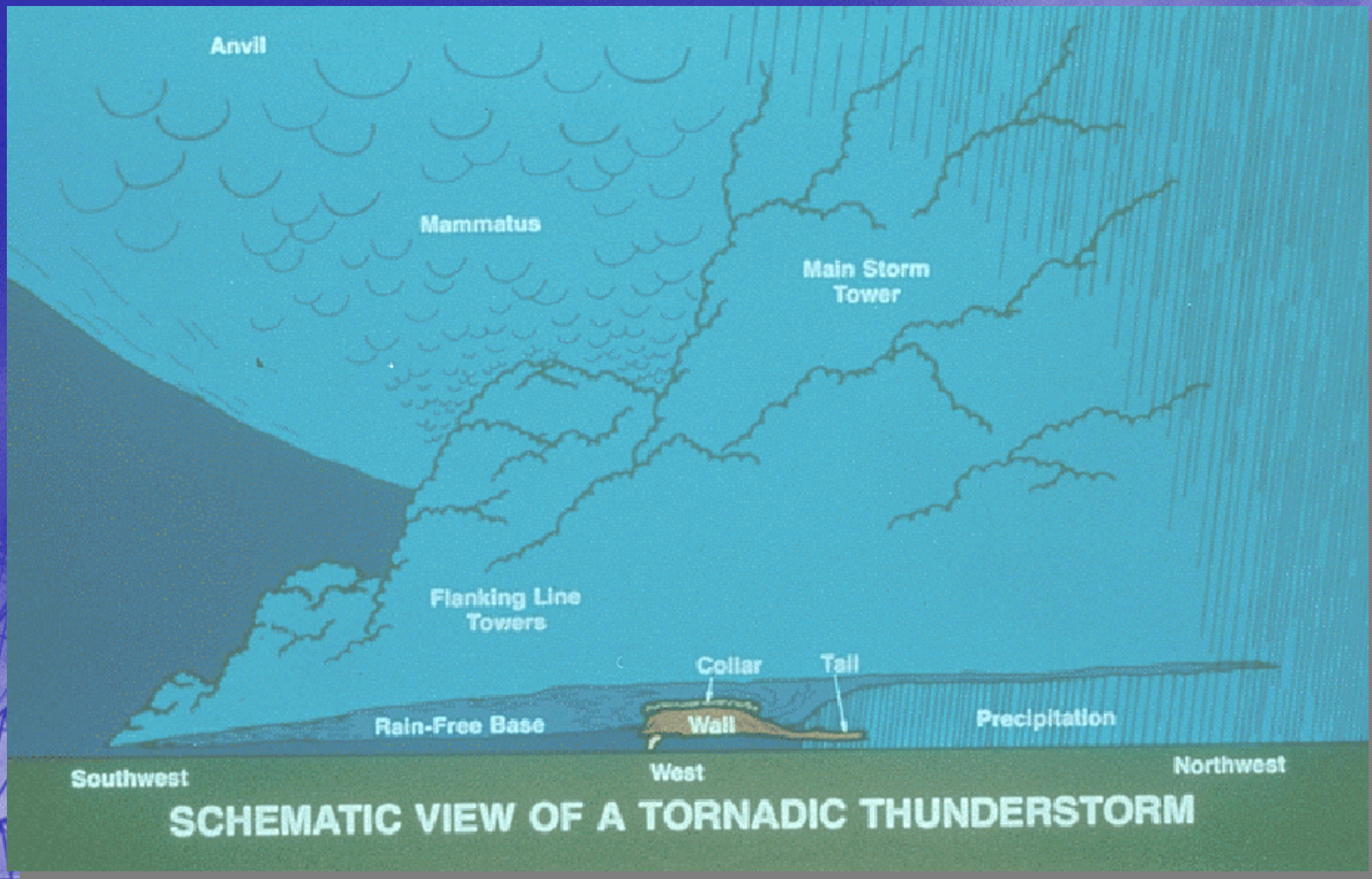
For example...Center Pivot Irrigation System tipped over



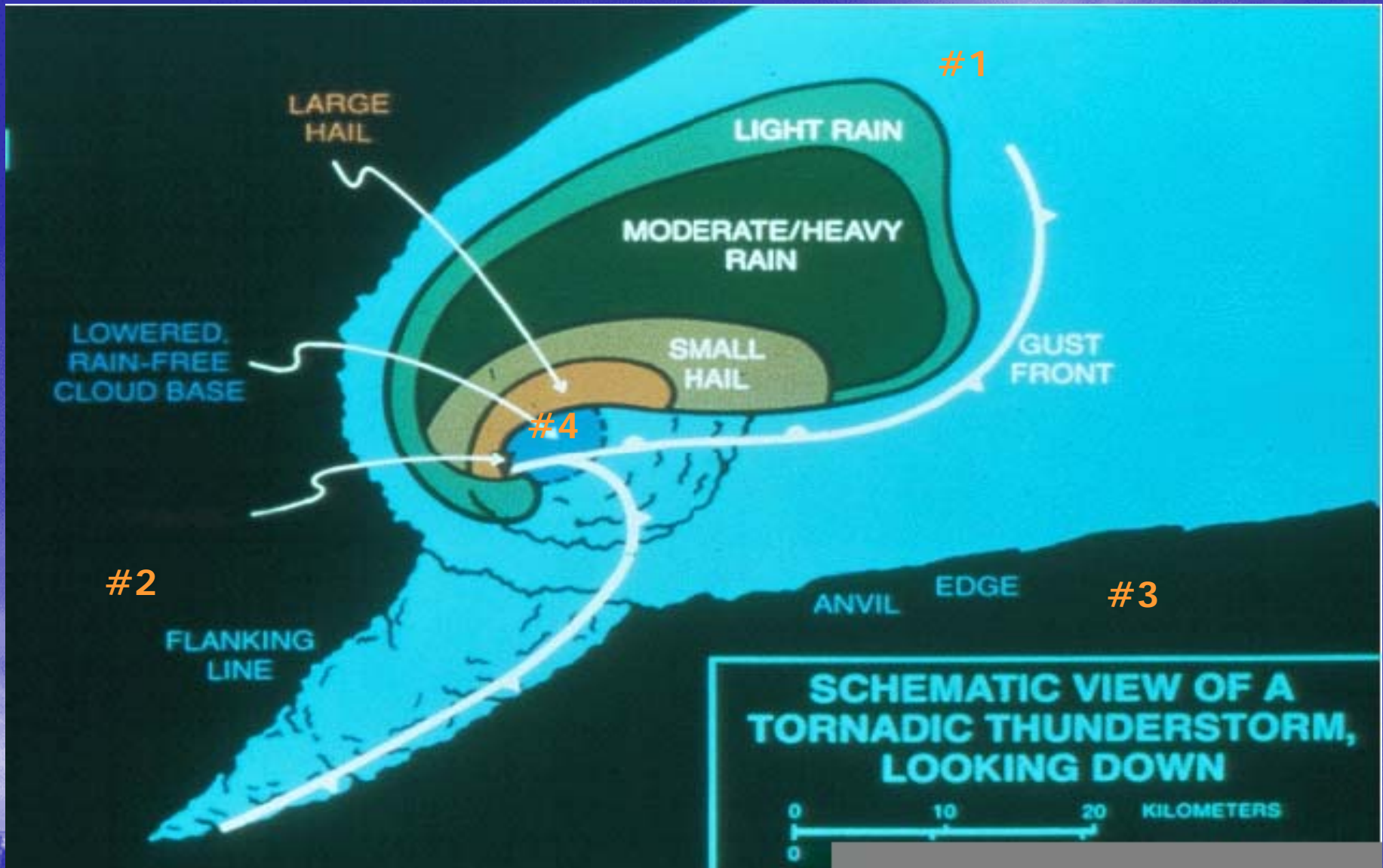
Viewing locations



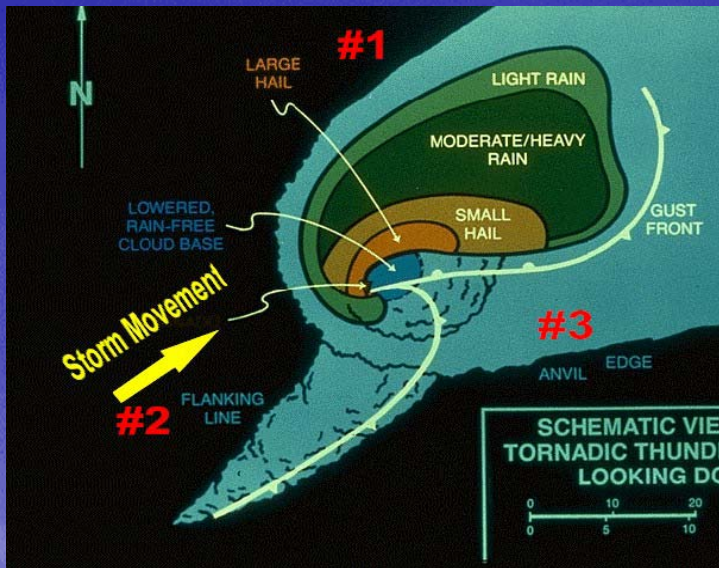
Side View of Supercell



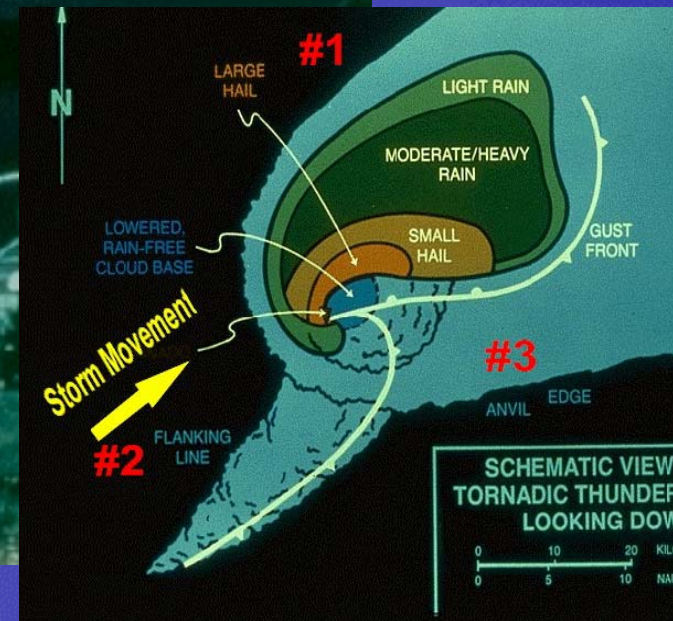
Top View of Supercell



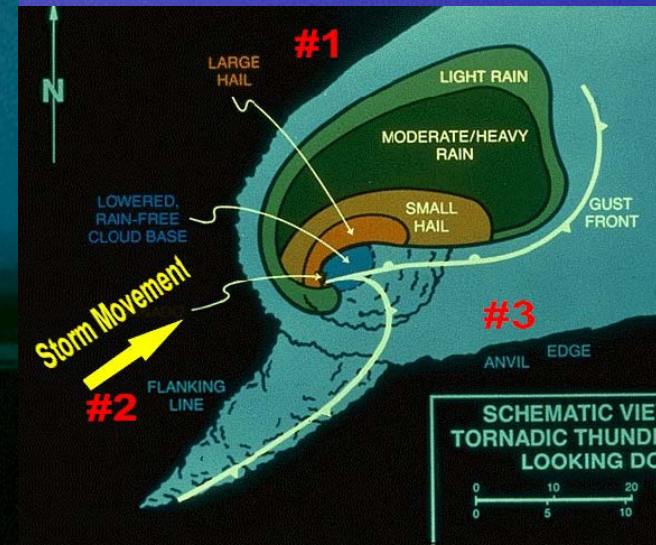
Position #1 – Looking South Several miles away



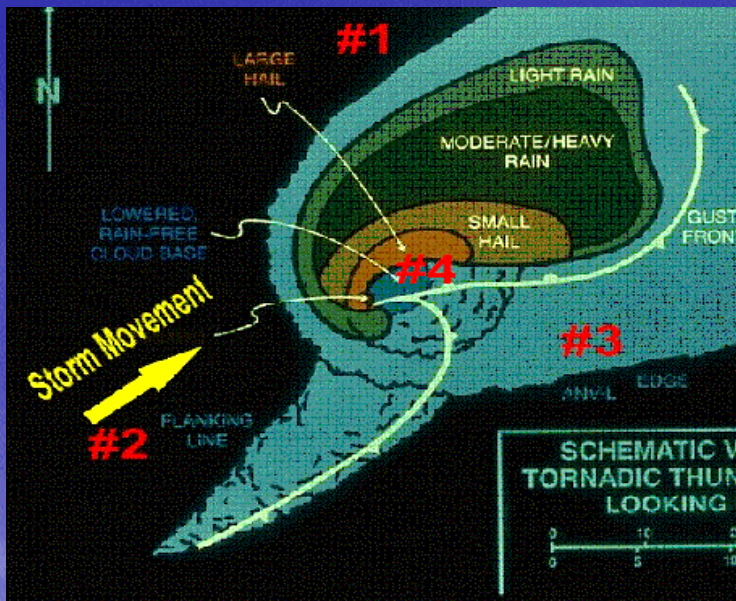
Position #2 – Looking Northeast



Position #3 Looking from the Southeast



Position #4 – Avoid this location!!



Cloud formations to look for



Upper Level Storm Clues for reporting

Best seen about 20 miles from storm

- Hard, flat, cirrus anvil top - Top of the atmosphere where the cloud top flattens out.
- Overshooting top or dome - A dome of clouds which presses above the anvil top. When it persists for 10 minutes or more this is indicative of a very strong updraft and severe weather.

Cloud clues to identify hail producing thunderstorms

Overshooting Top



Anvil with overshooting top

Mid Level Storm Clues

Best seen 10-20 miles from storm

- Main Storm Tower
 - Solid appearance with cauliflower texture
 - May be tilted, indicating strong shear
- Flanking Line
 - Row of towering cumulus stair-stepping up to main storm tower
- Surrounding Clouds Dissipating
 - Nearby clouds and other storms may dissipate while main storm dominates
 - All available energy will go to main storm tower

Low Level Storm Clues for reporting

Best seen 3-8 miles from storm

- Rain-Free Base - Low, flat cloud base with little visible precipitation falling and updraft towers above.
- Wall Cloud - Isolated lowering of the Rain Free Base, attached to the cloud base.
- Shelf Clouds
- Beaver's tail

Wall cloud and rain free base



Shelf Cloud



Shelf Clouds vs. Wall Clouds

What Is The Difference?

Shelf Clouds

Suggest downdraft/outflow

Move away from precipitation areas

Horizontally orientated and can extend for miles. May "roll" like a rolling pin.



Wall Clouds

Suggest updraft/inflow

Maintain position with respect to precipitation

Isolated, vertically orientated, *and rotating, like a spinning skater*



Beaver's Tail

Inflow feature – Usually east side of the storm



Mammatus Clouds

Underside of a thunderstorm anvil



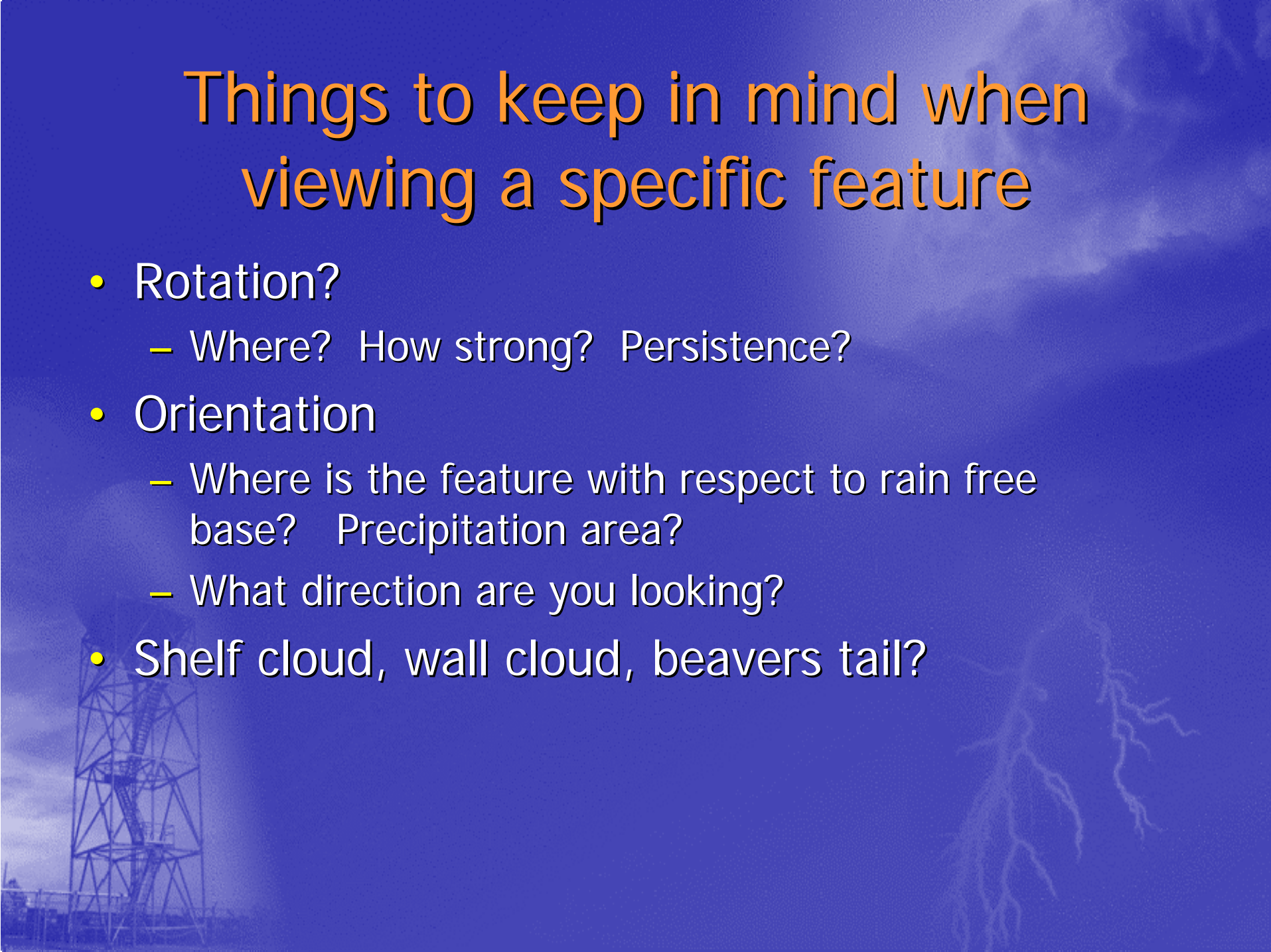
Butch Jorgenson
Shorewood
Looking West
Milwaukee County
August 18, 2005

Don't be fooled....



Things to keep in mind when viewing a specific feature

- Rotation?
 - Where? How strong? Persistence?
- Orientation
 - Where is the feature with respect to rain free base? Precipitation area?
 - What direction are you looking?
- Shelf cloud, wall cloud, beavers tail?



Would you call this into the
weather service?



No. This is just a rain shaft.

Notice, there is no wall cloud.



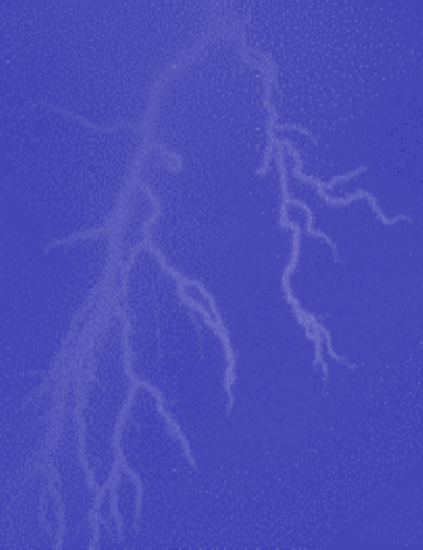
Should you be concerned about
this?



© 1998 Samantha Woon

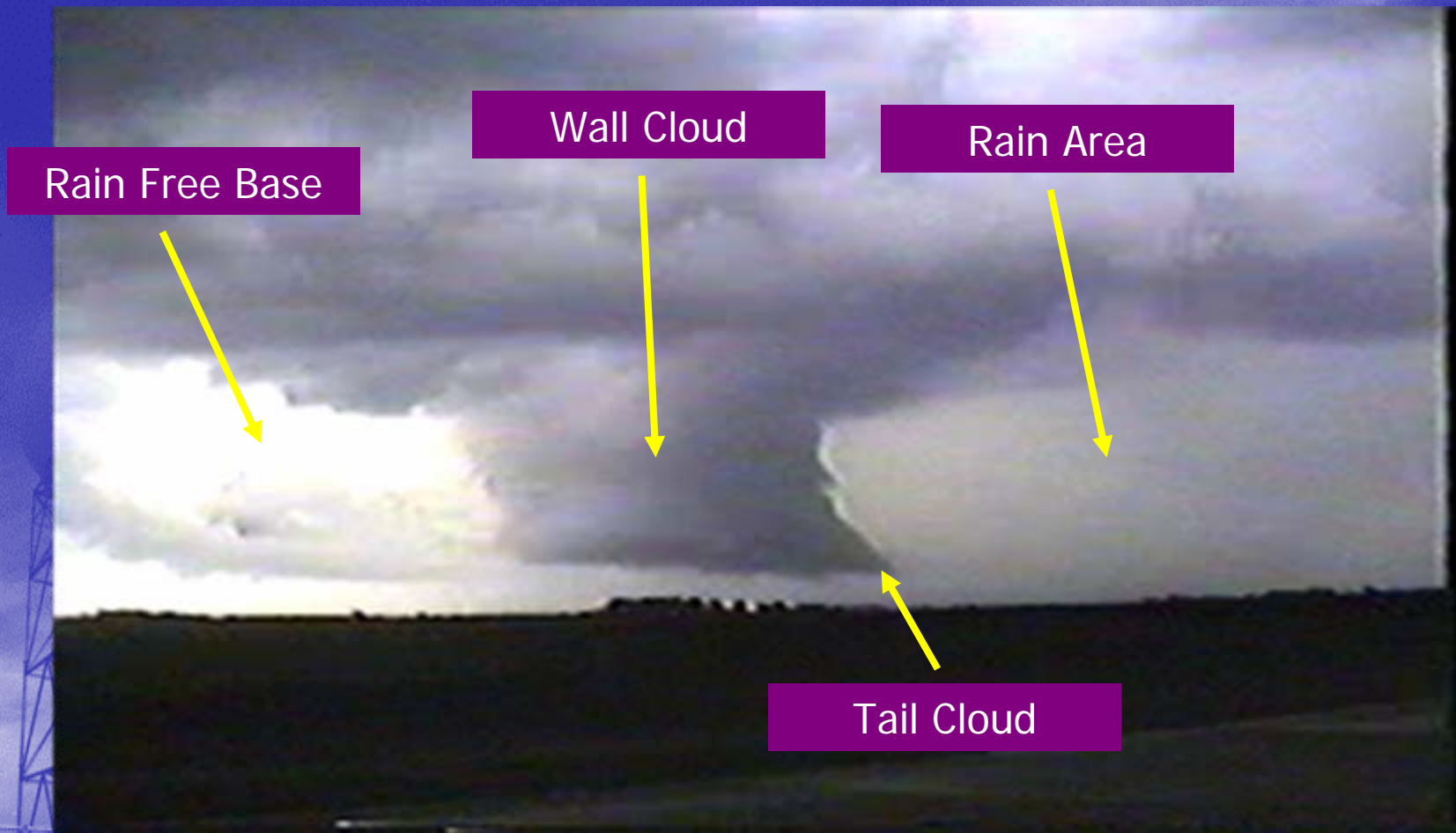
No. It is just a cloud shadow
(higher cloud casting shadow on a
lower cloud).

If you were spotting and saw this, what things might you
look for to determine if it was a tornado or not?



Quick review

Identify the features in this picture



Quick Review

Which of these pictures shows an outflow feature?



Shelf Cloud - Outflow

Quick Review

Which weather events in the following list would make a thunderstorm severe (according to NWS definition)?

Yes

A. Wind gusts of 60 mph

Yes

B. Tornado

No

C. Lightning causing power outages and tree damage

Yes

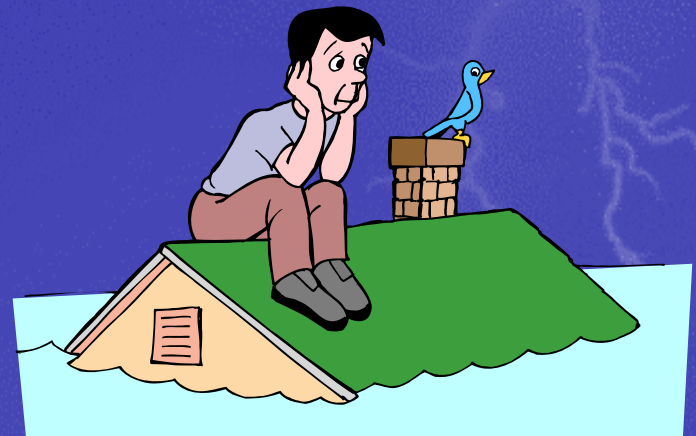
D. $\frac{3}{4}$ inch hail covering the ground

No

E. Flooding rains causing creeks and rivers to overflow their banks

Let's put it all together

- What to Report
 - Any size hail
 - Wind Damage (trees, shingles off roofs)
 - Estimated highest wind speeds (beaufort scale)
 - Flooding (water washing out roads, ditches full)
 - Wall clouds, shelf clouds, beavers tail
 - Tornado



Winter snowfall reports are also needed

Skywarn spotting is a year round job!

What to report:

- 12 and 24 hour snowfall
- Total depth of snow on the ground
- Heavy snow of 1"+ per hour
- Any ice accumulation

When and how to report:

- 2 X per day (morning and evening)
- Use the 800# to make your reports
- Or use our internet reporting system



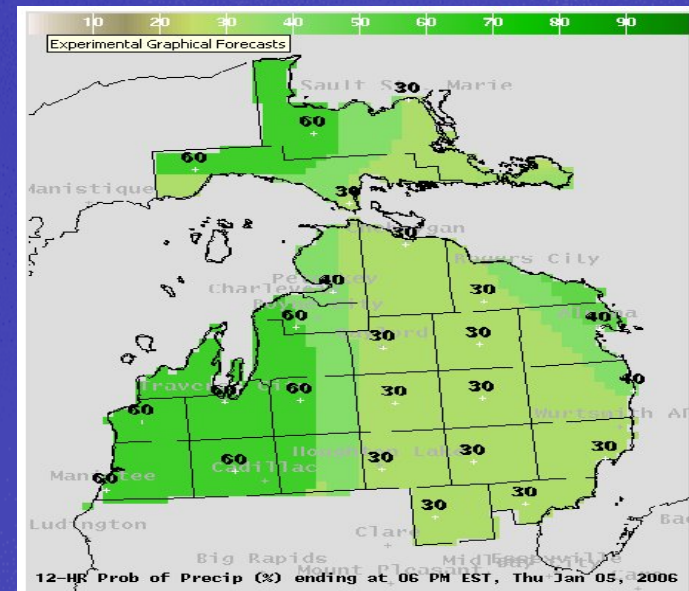
Remember to use the TEL method when making your report

- Time – When did it happen?
- Event – What did you observe?
- Location – Where did this occur?



Your NWS on the internet

- Digital Weather Grids, Warning Maps, Radar and Satellite
 - Detailed forecasts out to 7 days, includes hourly data
 - Map of our area with current watches and warnings



An online reporting system which allows spotters to send reports directly to forecasters at the NWS

Severe Weather Report Form		
Click Here for the Winter Weather Report Form		
Date & Time		
Date		Time
<div>Dec / 08 / 2005</div>		<div>13 : 41 EST</div>
		<input type="radio"/> Estimated
		<input type="radio"/> Exact
Location		
Select County, State		City/Town
<div>Otsego, MI (137)</div>		<div>2 East of Gaylord</div>
Weather		
<input type="checkbox"/> Tornado		
<input type="checkbox"/> Funnel Cloud		
<input type="checkbox"/> Wall Cloud		
<input type="checkbox"/> Hail		
<input type="checkbox"/> High Wind		
<input type="checkbox"/> Flood		
<input type="checkbox"/> Flash Flood		
<input type="checkbox"/> Other		
* Note if there is rotation in narrative.		
Size:		
Wind Speed:		
		<input type="radio"/> Measured
		<input type="radio"/> Estimated
Damage, Injuries, Narrative		
Any Damage?		<input type="radio"/> Yes <input type="radio"/> No
Was Anyone Hurt?		<input type="radio"/> Yes <input type="radio"/> No



Online Weather Reporting System

New to eSpotter? [[Register Here](#)]

eSpotter is a system to facilitate the submission of spotter reports online. The system is being developed to enhance and increase timely & accurate online spotter reporting and communications between spotters and their local weather forecast offices. The use of the system is currently available for trained spotters and emergency managers. eSpotter enabled offices are listed at the bottom of this page.

Registered Users: Log In

Email Address:

Password:

Forgot your password?
[Click here.](#)

Connections made to this system are monitored. Your email address is used to verify that you are authorized to access this system, and to provide a means for contacting you to follow up on weather information you submit.

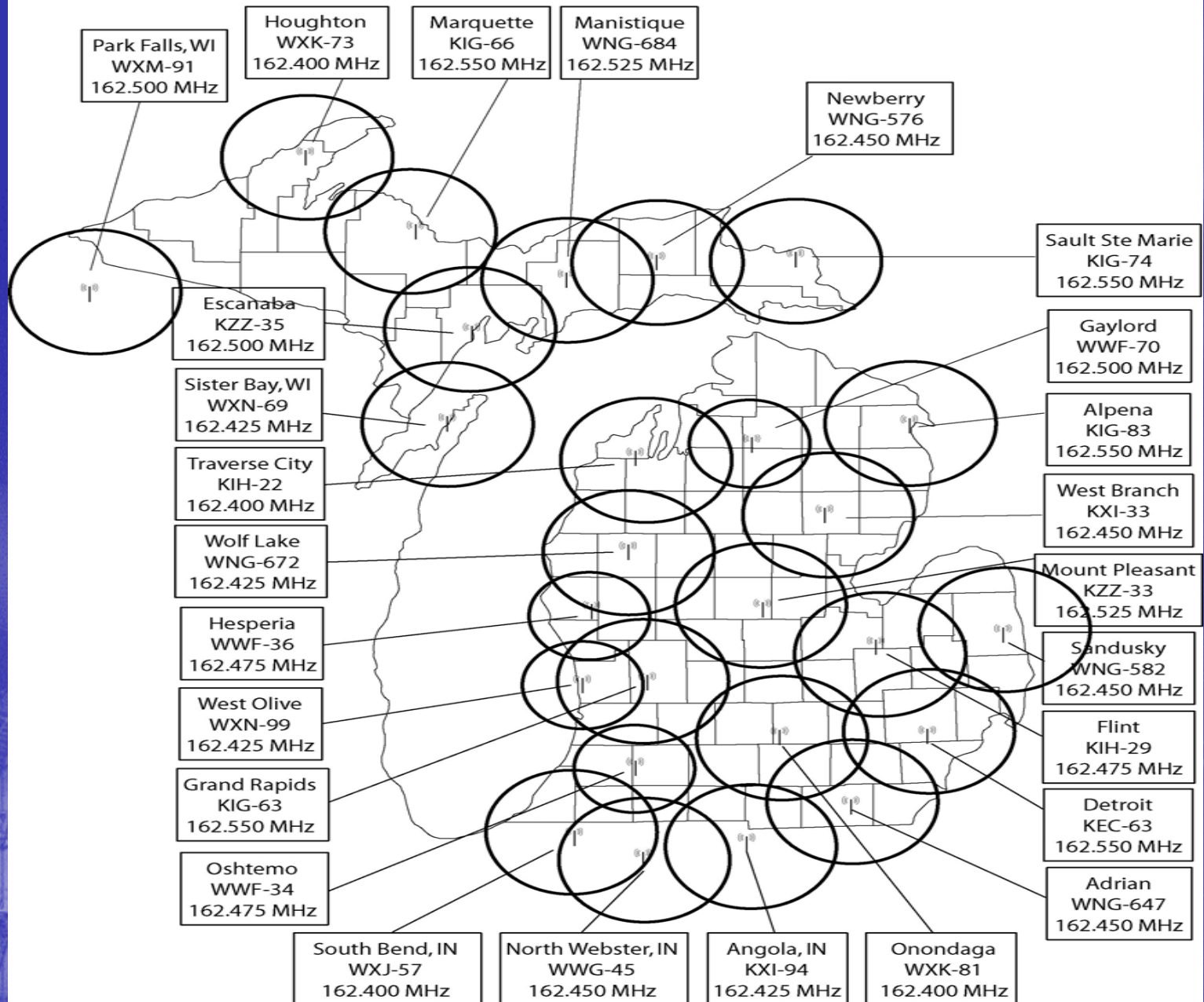
- **Big note:** Real time life threatening severe weather reports should be **CALLED** into the NWS on the 800#.

Registration is free and only takes a few minutes.
www.weather.gov/gaylord

NOAA All Hazards Weather Radio

- Voice of the NWS. Network of 583 stations nationwide
- NOAA Weather Radio can be heard by about 90% of the U.S. population
- Continuous weather information broadcasts from local forecast offices of:
 - Warnings
 - Watches
 - Forecasts
 - Observations
- For more information, visit the NOAA Weather Radio Web Site at www.nws.noaa.gov/nwr

Michigan NOAA Weather Radio Coverage





Questions or comments???

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www.weather.gov

www.weather.gov/gaylord